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THE VALUATION OF AUSTRALIAN WHEAT FOR COMMERCIAL PURPOSES.*

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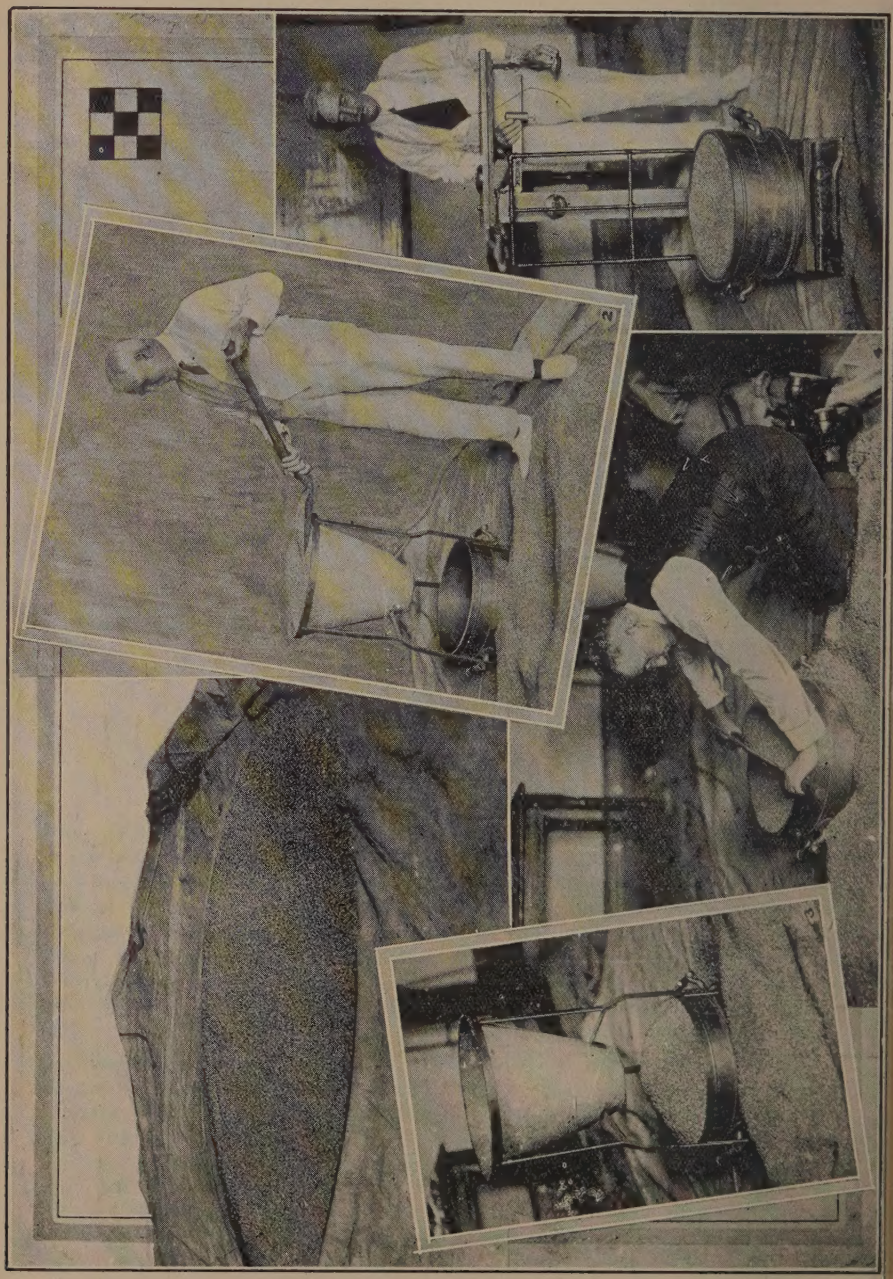
I.—THE NECESSITY FOR TRADING STANDARDS.

Commercial standards, for the purpose of trading in Australian wheat, were unnecessary in the early days of our agricultural history when the market was a restricted and localised one. Under such circumstances wheat could be, and was, sold by sample, *i.e.*, its quality could be judged by a fair sample shown to, and examined by, the buyer at the time of purchase. Immediately, however, the personal contact between buyer and seller was broken or became impossible, as in the case of wheat sold for overseas, then commercial trading standards became necessary in order to smooth out the difficulties incident to trading when long distances separated the seller and the buyer.

The principal standard by which wheat is valued and marketed throughout Australia is known as the f.a.q. Under this standard different parcels of wheat are bulked together and sold according to what is regarded as their fair average quality; it is from the initial letters—f.a.q.—of the three words in this term that the name of the standard has been derived. It has become recognised, by custom, as the commercial abbreviation for that term. This standard relates to the crop of a particular season only, and it is, therefore, necessarily fixed annually and, as the standard represents the season's crop, it cannot be fixed before the bulk of the crop has been delivered.

* Revised and enlarged from the notes of an address given at the Perth Branch of the Economic Society of Australia and New Zealand, 2nd May, 1935.



II.—THE ADOPTION AND FIXING OF THE F.A.Q. STANDARD.

As far as can be ascertained the f.a.q. standard was first used in South Australia in 1888, when the Adelaide Chamber of Commerce was formed and fixed the f.a.q. standard for the season 1887-1888 and declared its bushel weight to be 64 lbs.; in Victoria when the Melbourne Chamber of Commerce fixed it at 63 lbs. for the season 1891-92; and in New South Wales for the season 1898-1899 at 61 lbs.

The f.a.q. standard, with a bushel weight of 62 lbs., was introduced into Western Australia in the season 1904-05, and the system, or modification of it, has been used in all exporting States ever since. Although there is an independent standard for each State the procedure adopted for fixing the f.a.q. standard is similar throughout the Commonwealth.

In Western Australia the fixing of the standard is undertaken jointly by the Perth and Fremantle Chambers of Commerce, who bear the expense in connection therewith. The actual proceedings take place in alternate years at the headquarters of each Chamber. Last season (1933-34) the standard was fixed in Fremantle, this season in Perth. The President of the Chamber at the headquarters of which the proceedings are carried out is for the time being in charge of the function, and is assisted by leading wheat traders and millers of the State, who comprise the grain committees of both Chambers.

Until the season 1928-29 the Western Australian f.a.q. standard was fixed from representative samples collected by the Chambers of Commerce from centres at which wheat was delivered throughout the wheatgrowing areas. These samples were in the proportion of 1 lb. for every 800 bags (2,400 bushels), which had been delivered up to about the 20th January. Obviously the sample so collected should have been a fair average one of the wheat delivered, especially as it was specifically stated in the instructions issued for collecting the samples that the sample forwarded for the purpose should be a fair average one, and not a picked one. It was found, however, that collectors with a natural desire to advance the interests of their district frequently sent samples of special quality. Such picked samples, however, did not benefit any particular district, but they did handicap the committee which fixed the standard, and caused serious trouble and expense to exporters consequent upon arbitration cases which arose as the result of the standard adopted being rather better than what was really the f.a.q. standard. To remedy this defect in the collecting of the samples, the original method was abandoned, and since 1928-29 the practice has been to collect the necessary samples from the wheat received at each of the different ports from which Western Australian wheat is exported.

Prior to ascertaining the bushel weight of the State standard, it is usual to ascertain the bushel weights of the parcels received from each port. These weights are for the information of those in the trade; they are, therefore, recorded, but no declaration is made regarding them.

When the bushel weights of the parcels from each port have been ascertained the parcels are mixed together, the quota from each port being proportional to the current season's production of the wheat zone served by that port, as estimated by the Government Statistician. After the samples so collected have been thoroughly mixed, the composite bulk is ready to be measured and weighed in the "imperial" bushel.

It is essential, for the purposes of comparison, that the method of ascertaining the weight should be carried out in a recognised conventional manner. The bushel measure is first placed under a funnel-shaped hopper of standard

design, holding about 80 lbs.; its outlet, which is at a definite height above the top of the measure, is fitted with a slide, which is kept closed until the hopper is filled. After the hopper has been filled the slide is withdrawn, when the grain gradually fills and overflows the bushel measure, but with a cone-shaped surplus above the top. The surplus above the top of the measure is then struck off by means of a rounded rule or straight edge. It is necessary that the "striking" of the bushel be carried out without moving the measure, and without vibration, as this would cause some consolidation of the contents, and thus increase the bushel weight.

As befitting such an important commercial proceeding, the work is carried out with scrupulous accuracy and attention to detail; every possible precaution is taken to see that the calculations and weighings are absolutely correct and the mixing thoroughly done. It is impossible to conceive of more careful methods being used for the *determination* of the bushel weight.

After "striking" the bushel, the weight of the contents of the measure is ascertained by careful and accurate weighing on certified scales. Those present then consider whether this weight shall be subject to a draft allowance before being officially declared. Usually a deduction ranging from ¼ to 1 lb. is made. When the decision regarding the draft allowance has been arrived at, a declaration, as hereunder, is signed by the members and officials present. The declaration for this season read:—

> "We, the undersigned, present at the Chamber of Commerce, Perth, on Wednesday, the 20th February, 1935, at the fixing of the weight of the standard bushel of f.a.q. Western Australian wheat for season 1934/35, hereby certify that it was fairly taken, and the weight fixed, namely, 62½ lbs. per imperial bushel, in our opinion, is the proper weight for the season 1934/35."

III.—THE DEFECTS OF THE F.A.Q. STANDARD.

Bushel Weight of Commercial Wheat an Unreliable Guide of "Quality" or "Value."

It is significant that the only feature in the official declaration of the f.a.q. standard concerning its quality is that relating to its bushel weight. The emphasis placed upon this feature is due to a very general belief in the adequacy of the bushel weight to supply accurate information regarding the general quality of the commercial wheat* to which it refers. It is probably based upon the fact that the bushel weight of commercial wheat is influenced by the amount of unmillable material mixed with the millable wheat; for instance, the bushel weight of the current season's f.a.q. standard is increased by 1lb. when the unmillable material is removed from it. This has led to the inference that the bushel weight of commercial wheat is an all-important and reliable guide for assessing the relative values of different parcels of wheat. This is a fallacy. As a measure of "baking quality" it is of no value; as a guide to "milling value" it is insufficiently accurate for modern commercial purposes. It is not even a reliable guide to the amount of unmillable material in commercial wheat of the same type. Shier† found that one sample of commercial wheat with 97.0 per cent. of millable wheat had the same bushel weight as another sample containing nearly 1 per cent. (0.8 per cent.) more millable grain in it and worth 3d. per quarter more. Nor can it be regarded as a guide to the milling value

* The term "commercial wheat" is used to indicate the mixture of millable and unmillable material usually found in parcels of wheat as offered for sale. The unmillable matter usually consists of screenings, backbone, straw and foreign matter, which includes weed seeds and grain of other cereals.

† Recorded by the author in "The F.A.Q. and other Commercial Standards for Trading in Australian Wheat," Jour. Dept. Agric., W.A., Vol. 3, Sept., 1926.

of parcels of wheat containing the same quantity of unmillable material. Roberts* found experimentally that a parcel of wheat containing exactly the same quantity of unmillable material (4.2 per cent.) as that of the f.a.q. standard, with which it was compared, had a bushel weight of 58 lb., or 4½ lb. less than that of the f.a.q. The unmillable material in both cases was of the same kind, but in the case of the f.a.q. standard, screenings predominated and constituted about 3.8 per cent. by weight of the total sample; in the other sample the principal unmillable material (3 per cent.) was "cocky chaff" (empty glumes).

If a trade practice of deducting ½d. per lb. for every lb. below the bushel weight of the f.a.q. standard be followed the lightweight sample would be subject to a dockage of 2d. per bushel. The bushel weight of its millable grain was, however, 66¼ lb., or more than the bushel weight of the millage grain (63¼ lb.) of the f.a.q. standard. On the same basis the real value of the parcel was 1½d. per bushel more than the f.a.q. standard. Thus the commercial wheat "bushel weight" valuation was in error in this instance to the extent of 3½d. per bushel.

The bushel weight does not even correctly indicate the milling value of the same types of commercial wheat containing varying proportions of grain. Evidence on this phase was furnished during the fixing in Western Australia of the arbitrary f.a.q. standard for the current season, when it was found that one of the composite parcels prepared in connection with the fixing of the standard, and containing 23 per cent. of admittedly low value wheat, had exactly the same bushel weight—62 lb.—when weighed in the imperial bushel, as another parcel containing 16 per cent. of the same low quality wheat, the other components of both parcels being identical.

Using the bushel weight of commercial wheat as a reliable guide for assessing its value for commercial purposes is analogous to using the unreliable lactometer test instead of the accurate Babcock test for assessing the value of milk for butter making.

Ignored by Overseas Arbitrators.

As the f.a.q. standard is primarily an export standard, and because of the prominence given to the bushel weight in the official declaration of that standard, it is obvious that it is intended that the bushel weight shall play a very important, if not vital, part, in the settlement of overseas disputes, when they arise, regarding "milling value." The irony of this, however, is that despite the scrupulous care taken to determine and declare the bushel weight it is considered of no importance by the arbitrators dealing with disputed claims, for it is ignored entirely by them.

It may be asked: "If the bushel weight of commercial grain is so unreliable and unsatisfactory, why are such pains taken to determine it each year?" There is no logical reason for doing so; it is probably the survival of an old practice which commenced in countries where wheat was thoroughly cleaned or dressed and possibly when such wheat was sold by the measured bushel instead of by weight as at present. Under such conditions the bushel weights taken were in effect the bushel weights of clean grain, and, as will be shown later, they were then of real value for assessing the relative value of different parcels.

Inadequate Description for Valuation.

Another serious defect of the f.a.q. standard is the lack of definition, specification, or description regarding its components. It is true that the actual sample is available for comparison, but this involves an assessment according to the per-

* Agricultural Adviser, Department of Agriculture, Perth, W.A.

sonal judgment of those concerned. The interests of those concerned are those of buyer and seller and the viewpoints are not always the same; in consequence disagreements and disputes arise. This was the position when, during the season 1923-24, the Department of Agriculture was called upon to issue certificates for cargoes of export wheat; the department was required to certify that the wheat was equal in quality to the f.a.q. standard. Instead of being of prime importance the bushel weight of the standard was found to be of little or no assistance in assessing the relative value of parcels tendered for shipment. Assessment by comparison was then a matter of the personal judgment of the exporters and inspectors; disagreements were incessant and there was a constant call for adjudica-

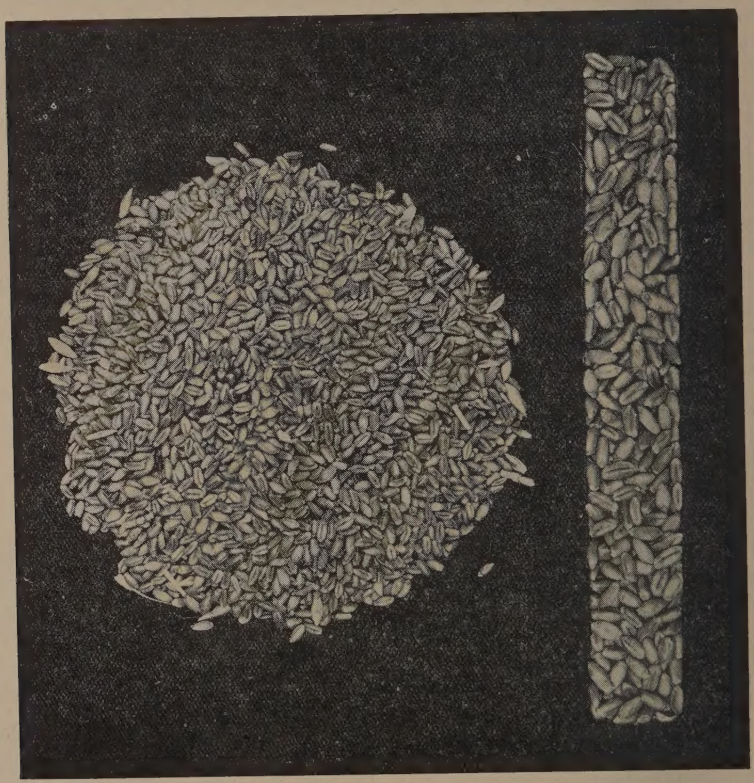


FIG. 2A.

F.A.Q. Standard wheat.
Bushel weight 62½ lbs.

Millable grain
97%

The bushel weight of commercial wheat is an unreliable guide of "quality" or "value." Compare with Fig. 2B.

tion. The need for a definition or description of the components of the standard was found to be imperative if the departmental inspectors were to function satisfactorily, and if the work of certification was to be practicable.

The components of the standard were separated and defined. It was then found that the prime factor in the standard was the amount of millable wheat in it. The amount and character of the unmillable material was defined but was of

minor importance. It was, therefore, decided to use the percentage of millable wheat in the standard as the basis of assessment instead of its bushel weight. As no instruments were available to determine the percentage of millable grain in the parcels submitted, the Canadian practice of ascertaining it by the use of sieves was adopted and a satisfactory technique developed.

This basis proved satisfactory until this season, for previously the character of all the wheat inspected was what may be regarded as normal. This year, owing to an epidemic of rust in the Geraldton district, the character of the millable grain was affected and a larger percentage of small and thin grains was found in the crop

FIG. 2B.

Commercial wheat.
Bushel weight 62½ lbs.

Millable grain
97.8%

The bushel weight of commercial wheat is an unreliable guide of "quality" or "value." Compare with Fig. 2A.

from that district than had been usual. Some experiments carried out by Davenport* showed that these characteristics were reflected in the bushel weight of the millable grain. It has thus been found necessary for assessment purposes to have regard, not only to the percentage of millable grain in the parcel, but also to its bushel weight.

* Senior Agricultural Adviser, Department of Agriculture, Perth, W.A.

Since the adoption of the percentage of millable grain as the measure of quality, local disputes, previously so frequent, as to the relative value of the parcels are so rare as to be practically non-existent. If they do occur they are settled by measurable factors, in which both sides can have confidence, instead of according to the judgment of an individual.

As the result of the Wheat Inspection Branch valuing commercial wheat according to its percentage of millable grain instead of according to its bushel weight exporters are now as accustomed to think in terms of "percentage of millable grain" as in "bushel weight," and at Western Australian ports it is quite a common practice, though perhaps not yet universal, for exporters to ascertain the percentage of millable grain of parcels or cargoes shipped.

Since the certification work started during the season 1923-24 the departmental inspectors have examined and certified over 90,000,000 bushels of wheat. Their experience since the adoption of the simple millable grain basis of assessment has shown that this method is definitely practical and that, combined with the bushel weight of the millable grain, it is just as valuable for assessment purposes as the bushel weight of the commercial wheat is valueless.

Too Late for Commercial Purposes.

The very nature of the f.a.q. standard requires that a large proportion of the season's crops shall have been harvested before it can be fixed, and, in consequence, its determination has to be delayed for at least two months after wheat deliveries have commenced. This delay is unavoidable whilst such a standard is retained. This feature was most unfavourably commented upon by the President of the Liverpool Corn Trade Association in March, 1923, when addressing the Australian editors then touring Great Britain. He pointed out that one of the troubles of the trade in Liverpool (which of course, applied equally to other parts of the United Kingdom) was the delay which occurred in connection with the forwarding of standards of the new Australian crop. He further stated that it was then March, and the standards had not been received, although the cargoes sold according to those standards had arrived. This unsatisfactory phase of the matter is well illustrated by the quantity of wheat exported prior to fixing the f.a.q. standard during the 1925-26 season, for which figures are available. In that year it could not be fixed, as is usual, until nearly the middle of February and at that date 4,827,597 bushels, or 41 per cent. of the season's total exports (to the end of July), had been shipped, and by the time the sample was received in Great Britain this had increased to 63 per cent.

Unfair to Farmers and Districts.

The recent Royal Commission* carefully examined the f.a.q. system and drew attention (Section 245, ii) to another serious defect in consequence of which many farmers, and some districts, are unjustly treated. They found that the farmer who produces wheat of better milling value than the f.a.q. standard receives no better price per bushel than the f.a.q. price, though the farmer who has wheat of lower milling value than the f.a.q. is penalised, *i.e.*, he is paid a lower price per bushel for it, the extent of the reduction depending upon the deficiency below the f.a.q. standard. In opposition to this view it is sometimes contended that under the present system the farmer receives a better price for grain of superior milling value because of its higher bushel weight. It is true that for a *measured* bushel of wheat weighing 64lb. per measured bushel the farmer will receive payment for 1 1-15th "conventional" bushels of 60lb. each. Wheat, however, is not sold by the

* Royal Commission on the Wheat, Flour and Bread Industries, 1934, Second Report.

measured bushel and I have yet to meet a farmer selling, say, 60,000lb. of wheat having a bushel weight of 64lb. who has received more for this quantity than a farmer with 60,000lb. of wheat weighing 62½lb. to the bushel. The only advantage that he will reap is a saving in bags, as, other things being equal, the wheat packs better. On such a parcel (60,000lb.) he would require seven bags less to hold the wheat.

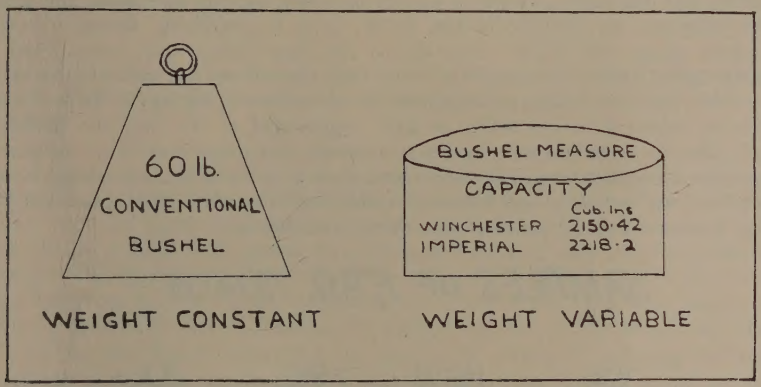


Fig. 3.—Australian Wheat is Sold by Weight, not by Measure.

From the State or national standpoint there is similar injustice and loss in connection with the f.a.q. standard. Cargoes which are below the f.a.q. standard in milling value are subject to dockage, though those of greater milling value are not entitled to any monetary advantage, that is, the buyer gets a better article than he expected without paying for it.

The manner in which farmers of whole districts may be penalised as the result of this inequitable practice is furnished by the experience in Western Australia during the current season. The wheat in the Fremantle and Bunbury zones is definitely better than that of the f.a.q. standard, as fixed, and according to which it is sold. The growers in those zones are, therefore, not receiving the full value for their wheat. The significance of this economic loss is evidenced by the fact that for every 1d. per bushel reduction in value there is an aggregate loss of £500,000 for every 120,000,000 bushels marketed.

Because of this defect of selling according to the f.a.q. standard which allows an unnecessarily high percentage of non-millable material, many farmers now cover up, or remove the "seconds" screens from their harvesters, thus deliberately lowering the commercial value of our main agricultural product by including a much larger percentage of unmillable material—foreign matter and screenings—than is necessary, with resultant economic waste. A further extreme case in this connection was that recounted by a West Australian witness, who stated to the Commission that some farmers now adopt the practice of grading their seed wheat and then selling the screenings mixed with their other wheat as f.a.q. wheat.

The Royal Commission* (Section 247) sums up against the f.a.q. as follows:—"A consideration of the advantages and disadvantages set out in the preceding paragraphs suggests that the f.a.q. system, though cheap and easy, is relatively inefficient and definitely unjust to districts and individual farmers who produce high grade wheat. *As the maintenance of standards of quality is an inherent necessity for any industry this conclusion is of considerable importance.*"

* loc. cit.

IV.—UNSATISFACTORY REMEDIES.

The Real F.A.Q. Replaced by Pseudo and Arbitrary Standards.

It may seem surprising that, after determining the bushel weight of the f.a.q. standard so acurately and with such meticulous care, those responsible should then consider it necessary to make a draft allowance. Believing, as the declaration implies, that the bushel weight is the all-important feature and guide for assessment purposes, the practice is due, firstly, to a commendable desire to have a standard which will enable exporters to fill their orders with wheat which is slightly better, rather than slightly worse, than that offered for sale, and, secondly, to provide for unavoidable contingencies in consequence of damage to the final wheat deliveries which it is impossible to have represented at the time the sample is fixed. By this means it was desired to minimise the number of those arbitration cases which are irritating to the buyer and no less to the seller, and which, in consequence, tend to destroy that harmony which facilitates trade. The graph herewith (Fig. 1) shows that the practice is common to all States.

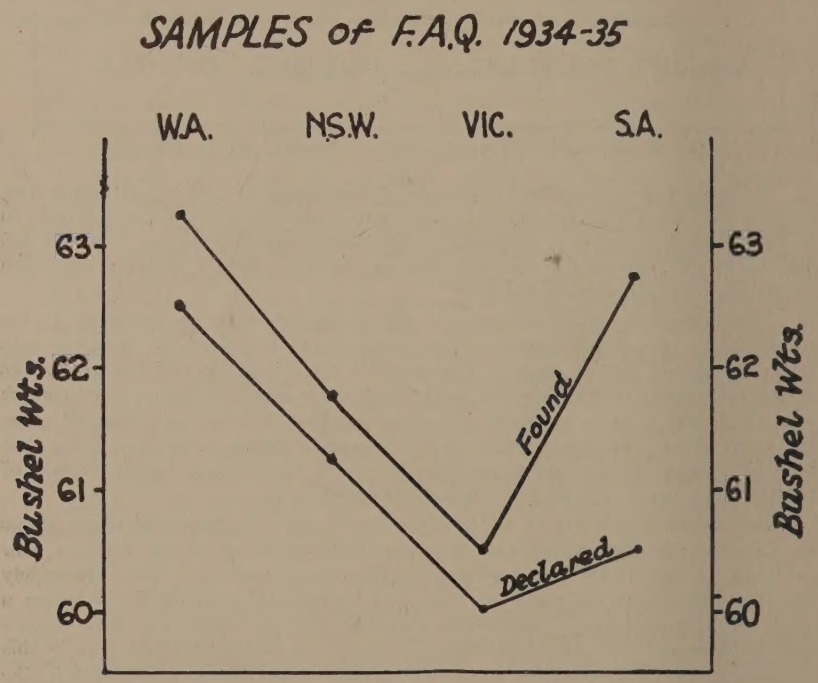


Fig. 4.

This was the merchants' first attempt to remedy a most important defect of the f.a.q. system. It has not been entirely successful and, in consequence, the exporters have endeavoured to find other ways of meeting the situation. In order to overcome the shortcomings of collection which occurred in Western Australia prior to 1928-29, the method of collection at the ports would now appear to err in the other direction in that the samples are of lower value than the wheat of the zones they represent. Thus, the position in Western Australia is that it can no longer be maintained that the official declaration really represents what is truly the fair

average quality of the State's wheat. Apparently, from the reports and comments which appeared in the Press immediately subsequent to the fixing of the f.a.q. standard for this season in the other wheat exporting States, the position is the same in South Australia and Victoria. In New South Wales they have endeavoured to overcome this trade difficulty by declaring two fair average quality standards (surely a contradiction of terms) viz.—

No. 1	61¼
No. 2	57½

Despite this action the position in that State is still unsatisfactory and proposals for the adoption of the Canadian or similar grading system are being seriously considered.

It is thus evident that, in all the wheat exporting States, wheat exporters have found insurmountable difficulties associated with trading according to what is a real f.a.q. standard, and, in consequence, the real f.a.q. standard has been abandoned. In New South Wales two arbitrary standards are in operation and in the other States pseudo f.a.q. standards arbitrarily fixed and each lower than the real average. The New South Wales expedient is the more equitable, but it has the disadvantage that it involves the abandonment of the most desirable feature of the f.a.q. system, in that it prohibits the bulking together of all the millable wheat.

One of the objects underlying the practice of arbitrarily reducing the bushel weight by agreement may be entirely commendable from the exporters' point of view; because of the perils of arbitration it may be an excellent commercial practice to lower the value of the f.a.q. standard by reducing the bushel weight, and in other ways, but such cannot be justified on equitable grounds. This method of removing a defect is undoubtedly satisfactory to exporters and to overseas importers; to the exporters because the perils of arbitration are reduced—the lower the standard the greater the reduction—and the importer benefits by receiving grain of greater value than the standard upon which his estimate of value was based, and upon which the contract of sale was made. It is unsatisfactory to the miller unless he is able to secure his supplies from the selected portions of the harvest; if unable to do this, he is compelled to accept, without dockage, parcels of lower quality than the real average of the crop.

Selling according to such arbitrary standards intensifies the defects associated with the true f.a.q. standard. Moreover, the farmer has to bear the loss resulting from the lowering of the standard, whereas those responsible for lowering it suffer no pecuniary disadvantage.

The true f.a.q. standard can be fixed quite impartially and, therefore, its fixation was quite properly in the hands of the Chambers of Commerce. On the other hand, if an arbitrary standard must be fixed, this should be done by those who are entirely dissociated from those in the grain trade, who have most to gain from a low standard, so that even the slightest suspicion of partiality may be removed from its fixation.

V.—THE PRINCIPLES OF VALUATION.

There is, however, no need for the use of arbitrary standards, and, to avoid the loss associated with them, the time is ripe for a change from the present method to the next stage in the evolution of our marketing system. Obviously, any new system should be based upon principles which modern cereal science endorses as fundamentally sound, and which will also be governed by the purpose for which our wheat is required.

During the five seasons 1928-29 to 1932-33 the average quantity of wheat and flour exported and consumed locally amounted to the equivalent of approximately

177 million bushels of wheat. Of this 9½ per cent. was used for seed; 2½ per cent. for stock and (assuming the wheat exported was for flour production) 88 per cent. for milling purposes. It will thus be seen that wheat in Australia is primarily grown and sold for the production of flour and, to a minor extent, for stock feed. Its worth will, therefore, be determined fundamentally by its value to the miller, or to the merchant who buys for the miller. Primarily, therefore, and judged solely from the millers' standpoint, its worth will be governed by its *milling* value, *i.e.*, by—

(a) The percentage of commercial flour which can be won from the wheat, and

(b) Its behaviour in the mill, including the ease with which the wheat can be gristed.

A valuation on this basis is, however, too restricted. The miller as the manufacturer of a staple food supply of the world must have regard to the requirements of his immediate customer—the baker—who is more interested in the kind, than in the quantity, of flour produced, and whose requirements are in turn influenced by the demands of his customer—the bread consumer. The baker is concerned principally with the amount and the character of the dough which can be made from the flour, and the consumer with the general appearance and palatability of the baked bread. These collective requirements of the baker and consumer may be summed up in the term "baking quality."

It is thus obvious that the miller in valuing wheat must have a wider outlook than his own—a miller's—immediate viewpoint, and, in consequence, must have regard to its *baking* quality as well as to its milling value. Accordingly these two factors govern its commercial value. As these two characteristics are not necessarily and, therefore, not always linked together, any sound method for the evaluation of wheat for commercial purposes must assess each one separately.

(*a.*) *Baking Quality.*

Baking quality is not a simple characteristic, and in connection with the use of flour for making yeast-risen bread, for which purpose most of the flour is used, it has been defined by Sir Albert Humphries as "the sum of excellence on several points." Its nature is, therefore, not simple, it is indeed very complex and includes many chemical and physical characters, such as "colour," "bloom," "texture," "diastatic activity," "water absorption capacity," and "protein (or gluten) content and quality." Under varying circumstances each of these characters may assume relative degrees of importance, but in Australia, at the present time, the dual characters of "protein quantity and quality" may be regarded as the predominant and important factors of "baking quality."

Because of its complexity, long bakehouse experience or a series of laboratory tests are necessary in order to accurately determine the "baking quality" of a particular parcel of wheat, but most of those characters which are most likely to vary from parcel to parcel are constitutional or inherent to the wheat variety. Baking quality is thus largely a varietal characteristic. This fact provides the miller with the first means of assessing the value of wheat for baking purposes. Obviously the application of this fact is to group the varieties in cultivation into classes according to their relative "baking quality." As the "baking quality" of all varieties is, however, also influenced to some extent by their environment, *i.e.*, by the climatic (or district) and soil conditions under which they are grown, it follows that the strictly varietal classification will be modified by an intra-varietal sub-classification according to district and soil.

For instance, a Western Australian miller would place a different "baking quality" assessment upon wheat from the dry inland belt than upon that of the same variety from the wetter coastal districts.

Obviously, then, the initial step in connection with the valuation of Australian wheat is to divide it into classes by grouping together varieties of similar inherent baking quality, having regard to the influence of local environment. Such a plan has in actual fact been adopted, if not defined, in the Western Australian wheat trade, which now recognises two distinct classes of wheat. These are—

A. Those of superior baking quality, known as "Premier" wheat. This class includes such varieties as "Comeback," "Carrabin," "Pusa No. 4," "S.H.J.," etc., and

B. The main cultivated varieties to which no specific designation other than Western Australian, as a sub-class to Australian, has been given.

There are some who consider that the requirements of our present system now require a third class for varieties with a lower "baking quality" than the accepted minimum of Class B. Such a proposal is quite in accord with the principles of a sound "baking quality" classification, and, assuming that it is in accord with the general policy relating to the maintenance of Australian "baking quality," may be regarded as part of the present marketing scheme. The "baking quality" classification of the present system thus conforms to the modern principles of sound evaluation and there is therefore no need to change it.

It is suggested these classes be named—

Class A.—Australian Premier Strong White.

Class B.—Australian Standard White.

Class C.—Australian Soft White.

Reasons for Classification Names.

The names for the different classes are suggested because they are distinctive and descriptive.

The word "Australian" denotes their origin; that of "White" calls attention to a colour characteristic for which Australian wheat is favourably noted.

In the milling world the word "strong" has the same meaning as the word "hard," and the latter term could be used instead of "strong" as suggested. This is not desirable because, though in Canada the word "hard" is applied to their best "baking quality" wheat, it has a definite association with the word "Red" in the international wheat trade. Any association, however slight, of the word "Red" with Australian wheat is objectionable and likely to lower its commercial value, as such an association infers some departure from those distinct characteristics for which Australian wheat is noted, viz., its whiteness and brightness. The objection referred to does not apply to the use of the word "strong." This has no association with the term "Red"; it is distinctive and, because of its connection with the much-desired baking quality, "strength" conveys at once to the miller the character of the flour produced from such wheat without creating any impression of milling difficulty. "Strong" was the word used by Farrer in the early days of wheat improvement to denote his ideal of the new varieties he was producing. It is considered fitting, therefore, that the word "strong" should be applied to the standard for wheat of this type.

The word "standard" is used because this class will include most of the wheat grown in Australia and in consequence it is the standard class.

The word "soft" is used as it indicates its special characteristic and it is preferable to "weak."

Classification Standards.

Sufficient experience, as the result of bakehouse and laboratory tests, is available to enable varieties now in general cultivation, and as grown in different States, to be classified according to their baking quality or *kind* of flour they produce. It is suggested, however, that as far as is possible standards should be set to which the different classes should conform.

The wholemeal fermentation time test (*i.e.*, the "Modified Saunders" or "Pelshenke test") provides at present the most satisfactory simple method of estimating the dual characteristics of protein (or gluten) quantity and quality, which are of predominant importance in connection with the assessment of baking quality. Varieties which bakehouse experience has shown belong to the Premier Strong White class have a wholemeal fermentation time of 80 minutes or over. It is, therefore, suggested that any variety for inclusion in the "Premier Strong White" class should have a wholemeal fermentation time of at least 80 minutes.

With the object of maintaining the demand for Australian wheats in the British flour grist, it is believed that the baking or inherent quality of the "Australian Standard White" Class B. should not be permitted to become lower than at present, and, in consequence, varieties of lower baking quality than standard varieties, which have proved satisfactory in the past, should not be included in it. "Gluyas Early" is a typical variety meeting this requirement and, as its wholemeal fermentation time is approximately 30 minutes, no variety with a wholemeal fermentation time of less than 30 minutes should be included in the "Standard White" class.

These proposals are embodied in the accompanying graph, which has been designed by Dr. Nimmo, of the Department of Physics, the University of Western Australia, from data concerning the wholemeal fermentation time supplied by the Department of Agriculture. It indicates, by means of an exponential curve, the relative value of the protein quantity and quality of different wheats according to a scale of points ranging from 0 to 25.

CURVE SHOWING THE RELATIVE ESTIMATED BAKING VALUE OF WHEAT ACCORDING TO ITS WHOLEMEAL FERMENTATION TIME

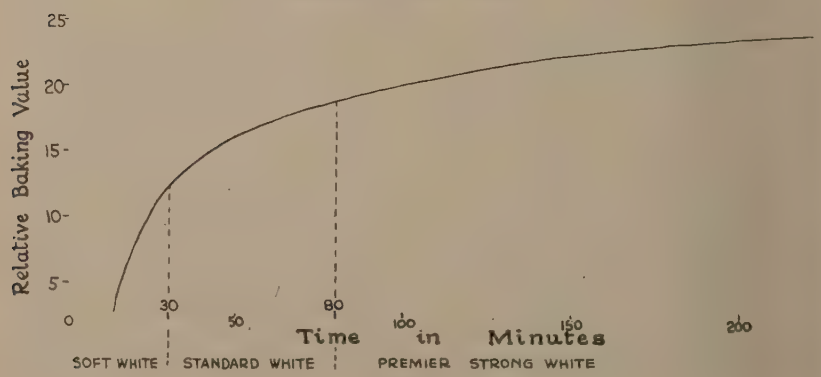


Fig. 5.

(*b.*) *Milling Value.*

Knowing, as the result of its classification, the *kind* of flour obtainable from a given parcel, its worth to the miller then obviously depends upon its "milling quality" or "milling value."*

Fisher† explains the position in the following words: "To the miller the desiderata of good wheat quality in the restricted sense of good *milling* quality are—

(1) A minimum content of dirt, weed seeds, etc.

(2) The wheat must be plump and of high test per bushel.

(3) It must be sound and of good colour, two characters which indicate freedom from damage.

(4) It should be of low moisture content.

These four characters are so important in determining flour yield, and certain flour characters, that they form the basis of the various grading systems in operation in America and elsewhere." That is, under the American and similar marketing systems, the classes and subclasses of wheat are valued and subdivided into grades according to their milling value.

These four requirements of good "milling value" constitute what another authority—Duly, in "Grain"—refers to as the "merchantable qualities" of wheat. The extent to which these requirements are met determines the relative commercial value of any particular parcel of wheat of the same class. They should, in consequence, form the basis upon which Australian wheat of any "baking quality" class is bought and sold.

The first of the four essential requirements, viz., "freedom from unmillable material," takes cognisance of the fact that a fundamental factor of the commercial valuation of wheat is the amount of millable grain in the parcel. Obviously the most satisfactory as well as the most practical way of ensuring recognition of this is to provide that the marketing standard shall be on a "clean wheat" or "millable wheat basis." On such a basis the relative value of a parcel of wheat, as far as this requirement of milling value is concerned, will be governed by the percentage of millable grain in it. This feature has the advantage that not only can it be estimated by visual inspection but it can be determined accurately, if necessary, by mechanical means.

The second requirement of "plumpness and high bushel weight" recognises that these characters are excellent guides to the amount of flour which can be produced from a given quantity of wheat. Investigations in the United States of America have shown that usually there is a very definite correlation between the bushel weight of the millable grain and the flour which can be milled from it. The higher the bushel weight the greater the flour yield. The graph herewith (figure 3) has been prepared from data published by the United States Department of Agriculture to show the correlation between weight per bushel and yield of "straight" flour. The information obtained was the result of experimental milling work during three years and including all varieties.‡

* The latter term is considered preferable, for it is found that the terms "baking quality" and "milling quality" are frequently used indiscriminately without regard to the very great distinction in meaning between the two. Often the word "quality" is used as being applicable to either or both. For the sake of clarity, and in order to avoid the confusion which arises from the loose use of these terms, it is proposed to use the term "milling value" in place of "milling quality."

† E. A. Fisher, M.A., D.Sc., Director of Research, The Research Association of British Flour Millers, January, 1935: "Flour Quality, its Nature and Control."

‡ S. J. Duly, M.A.: "Grain," 1928.

Any sound commercial wheat marketing standard should, therefore, include information regarding the bushel weight of the millable grain. The bushel weight of small quantities of wheat can be ascertained readily, in the field or elsewhere, by means of a chondrometer, a small simple instrument designed for the purpose. It has been adopted by the trade and has entirely displaced the estimation of bushel weight by personal judgment.

The first two characteristics, namely—

The percentage of millable grain, and

The bushel weight of the millable grain

furnish the most reliable information regarding the amount of flour which can be gristed from a parcel of wheat. They, however, provide no information regarding another matter of interest to the miller, and that is the behaviour of the wheat in the mill during the process of gristing. The ease or difficulty with

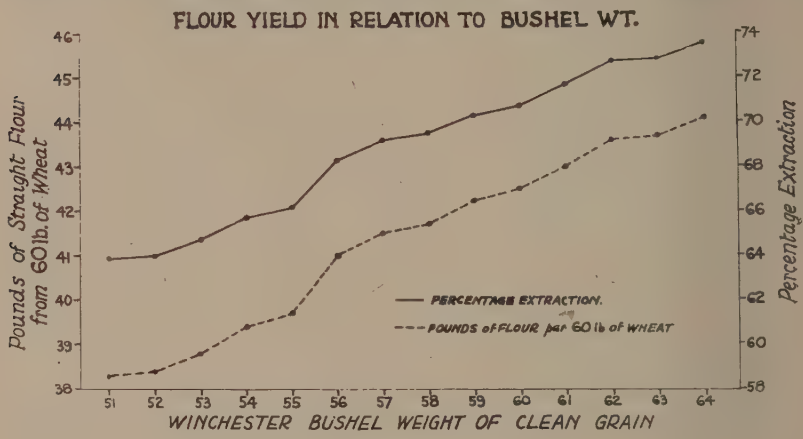


Fig. 6.

which wheat can be gristed, and any other peculiarity of gristing, are largely varietal and correlate with baking quality, and thus have been provided for in the primary classification made according to "baking quality"; further, the difference in this connection between varieties of the same class is relatively so small as not to be significant for commercial purposes.

The third and fourth characteristics deal with what is technically known as the "condition" of wheat. The third relating to "soundness" and "colour" requires that in the commercial standards reference should be made regarding the minimum quantity of sound grain of good colour necessary to comply with them. Soundness will include not only freedom from storage deterioration, damage resulting from adverse climatic conditions, and insect and fungal pests, but also freedom from objectionable smells which will affect the quality of the flour. In Australia the bulk of the wheat produced is sound and of good colour.

The fourth essential, that the wheat shall be of low moisture content, is of considerable importance, as an undue amount of moisture is a predisposing cause of deterioration during transport or storage. Furthermore, dry grain does not readily go out of condition, even when the storage temperature is high

and the grain is stored for long periods. The fact that the keeping qualities of wheat are governed by its moisture content is recognised in the grading system of America and Canada, and the maximum allowable moisture content of certain grades is specified. This is done for two reasons—

(1) As an indication that the grain in that grade is in a suitable condition for transport, and

(2) To indicate its relative flour yield.

Australian wheat is noted for its dryness and, unless exposed to rain or other external moisture during storage or transport, may be regarded as dry enough for storage or transport without deterioration. During the dry summer harvesting period the moisture content of Western Australian wheat was found, by the writer, to range from 7.95 to 11.2 per cent., with a general average of 9.33 per cent.* Its moisture content, however, varied with the humidity of the air and in the wet winter months the moisture content increased to 16.08 per cent. in the case of the "Standard White" wheats and to 15.95 per cent. in the case of "Premier Strong White" variety "Comeback."

Shier† found that, when the moisture content exceeds 11 per cent., an increase in moisture is reflected in the bushel weight of the grain roughly to the extent of a reduction of approximately 0.8 of a lb. in the bushel weight for every increase of 1 per cent. in the moisture content. The bushel weight of the millable grain is thus indirectly a guide to its moisture content as well as directly to the flour yield, which is affected inversely by the moisture content.

As the bulk of Australian wheat is harvested and stored whilst normally dry, it is not believed to be necessary to include details regarding moisture content in Australian marketing standards for such wheat. It should be sufficient, in the description or specification of the standard, to state that it is "dry," thus implying that its moisture content has not been increased by the addition of external water.

Summed up, the requirements of the sound assessment of the "milling value" of Australian commercial wheat are that it be valued according to—

Its percentage of millable grain.

The bushel weight of that grain and its colour and condition.

It is, therefore, essential for sound trading that this information regarding wheat offered for sale should be supplied to the prospective purchaser, and, in consequence, it should be supplied by the standard, or by the specification, relating to such wheat.

It has already been pointed out that the f.a.q. standard does not supply this information; it is desirable, therefore, that it be modified so as to meet the essential requirements of sound assessment.

Though such characteristics as colour and general appearance can be assessed as at present only by those with skill and experience a modern trading standard should include a description or specification of the components of the standard so that the character of the wheat to which they refer can be readily understood by the contracting parties. As far as is possible the standard should also include features capable of measurement by mechanical means in which both parties have confidence, as, for example, in the accuracy of chondrometer weighings. Such aids to the judgment, combined with a lucid specification, must foster confidence, reduce the number of disputes and thus make for a better trading atmosphere.

It will be seen that the description of the suggested modified f.a.q. standard complies with the above requirements.

* Sutton, Geo. L., Director of Agriculture, W.A.: "The Absorption of Moisture by Wheat Grain and its Relation to the Humidity of the Atmosphere," Journal of the Proceedings of the Royal Society of W.A., Paper read 9th March, 1920.

† "The F.A.Q. and other Commercial Standards for Trading in Australian Wheat," Journal Department Agriculture, W.A., Vol. 3, September, 1926.

Milling Value Standards.

Under the American grading system, and in common with other grading systems elsewhere, which, as Fisher* points out, are based upon the foregoing essential characters, there are seven "baking quality" classes, but these are further divided into eighteen subclasses. Each subclass is divided into five numerical grades and a sample grade thus making a total of 108 grades. In addition, each of these grades may be classified as "tough," "smutty," "garlicky," "weevilly," "ergotty" or "treated." There are thus a possible 648 grades. The numerical grades are sold according to—

The percentage of millable grain they contain, its bushel weight and its condition.

The sample grade is sold according to its trade description.

The Canadian marketing system also provides for numerous grades. In both countries these have been found necessary because of the many types of wheat grown, and because of liability to damage by frost and rain at harvest time. In Australia white wheat is grown throughout the continent, frost damage is less frequent and less severe and drier conditions obtain at harvest time; there is, in consequence, no need for the same number of grades. A much simpler marketing system is possible, though the same four essentials must be the basis of its grades or "standards."‡

For the suggested Class A—Australian Premier Strong White—it is considered that one standard only should be recognised, and that any wheat not reaching this standard should be included in the appropriate standard of Class B—"Australian Standard White." The bulk of the grain in this class should be "horny" or "steely" instead of opaque or starchy, as is that of the main standard varieties; in consequence the percentage of "steely" grain required (say, 95 per cent.) should be specified. Except for this the standard by which it is marketed should be the same as No. 1 for the other classes.

In the case of the "Australian Standard White" and "Australian Soft White" classes there would need to be two standards. The first to deal with wheat in normal condition and the second to deal with wheat not up to that standard, *e.g.*, out of condition, musty or with some objectionable taint. This second standard would be designated "sample" and would be sold as the "below standard" or "reject" wheats are sold at present, *i.e.*, according to a trade description indicating the special characteristics of the parcel. Specifications of the standards suggested are—

Standard No. 1 or *f.a.q.* (*modified*).—The wheat shall be dry and undamaged by moisture. It shall be free from weevils and other insects, and from smutty, musty or other commercially objectionable smell.

Of the millable grain there shall be 98.5 per cent. of white grain in commercially sound condition.

The bushel weight of the millable grain shall be stated at time of sale.

Note.—Any variation from the specified bushel weight to be adjusted as is the case under certain contracts of the London Corn Trade Association.

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* loc cit.

† Official Grain Standards of the U.S.A., 1935.

‡ The term "standard" is here used in the same way, and has the same meaning in connection with Australian wheat, as the term "grade" has in connection with American and Canadian wheat. It has been considered necessary to adopt the word "standard" because Australian farmers and dealers are accustomed, by usage, to regard the grading of wheat to mean to clean it from impurities, and to separate the cleaned grain into lots according to the size of its kernels; and not to mean, as in the Canadian and American sense, to classify commercial wheat according to its character and condition. The word "standard" in Australia is beginning to be used in the latter sense because of its association with the f.a.q. standard.

Standard No. 2 or *Sample.*—To be sold according to a trade description as to the condition, percentage and bushel weight of the millable grain.

The proposed standard differs but little from the present f.a.q. standard except that the bushel weight shall be of the millable grain, instead of the commercial wheat, and it requires the percentage of millable grain and its soundness to be specified, instead of estimated according to the personal judgment of the parties concerned. Whilst such a standard is based upon the same sound principles as obtain under the best grading systems operating in the wheat trade and conforms, under Australian conditions, to their requirements, it is in effect a modification of the f.a.q. system, retaining its advantages, particularly its elasticity and adaptability, but eliminating its defects.

F.A.Q. and Modified F.A.Q. Standards Compared.

How little difference there is between the proposed standard and the present f.a.q. may be seen from the following comparison:—

Specification of F.A.Q. Standard, 1934-35.	*Specification of the Suggested Modern Standard.*
According to the declaration and as found by an examination of the standard—	
(1) As stated in the declaration— The bushel weight of the *commercial wheat* (i.e., mixture of millable wheat and its associated unmillable material) shall be 62½lb.	The bushel weight of the *millable wheat* shall be as stated at time of sale and of the *specific* parcel.
(2) As found by an examination of the standard—	
(a) The wheat shall be dry and undamaged by moisture. It shall be free from weevils and other insects, and from musty and other commercially objectionable smells.	(a) The wheat shall be dry and undamaged by moisture. It shall be free from weevils and other insects, and from musty and other commercially objectionable smells.
(b) It shall not contain less than 95.8 per cent. of millable wheat.	(b) Its commercial value shall be based upon its *actual* percentage of millable wheat.
(c) Of the millable grain there shall be not less than 98.5 per cent. of white grain in commercially sound condition.	(c) Of the millable grain there shall be not less than 98.5 per cent. of white grain in commercially sound condition.

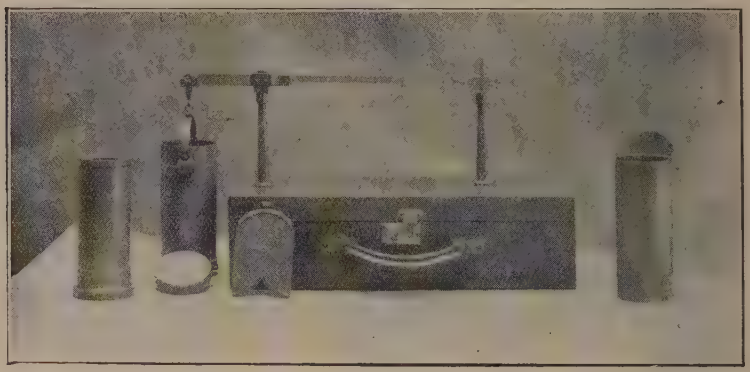
VI.—THE REAL REMEDY—THE MODIFIED F.A.Q. STANDARD.

It, therefore, provides the real remedy for the defects of the present system.

The specification is clear and the two factors—percentage of millable grain and its bushel weight—governing the milling value of the wheat are stated in measurable terms. The latter by means of the well-known chondrometer. The former by the aid of sieves, as in Canada or as in the United States of America, or with the assistance of a device known as a "kicker," which is used as a rapid commercial means of determining the amount of "dockage-free" material. The officers of the Wheat Branch have adopted a simple instrument which quickly separates sufficient millable grain from its associated material to enable its bushel weight to be determined. They are now endeavouring to increase its efficiency so that the percentage of millable grain can also be determined, using the same chondrometer as the weighing instrument.

The modified standard thus has the advantage that two important features can be measured in cases of dispute or whenever otherwise considered advisable.

This will obviously remove that serious defect of the f.a.q. and pseudo f.a.q. standards which must always be associated with them whilst the settlement of disputes regarding value is dependent solely upon the personal judgment of an individual, specially skilled and experienced though he be.



THE STANDARD CHONDROMETER.

By means of which the bushel weight is determined and which can be adapted to determine also the percentage of millable grain.

The details relating to the present Australian marketing system are set out graphically in Diagram 1, and those embodying the proposed alteration in Diagram 2. It will be seen from a comparison of these how slight is the alteration suggested, and that it requires only a modification of the f.a.q. standard. Similar details relating to the marketing system of the United States of America are shown in Diagram 3. A comparison of this with Diagram 2 will show that, though the proposed system is much simpler, it is based upon the same principles as the more elaborate one.

If, as some suggest, provision for an additional "baking quality" class be made in the Australian system of marketing wheat, there will be three classes to correspond to the three subclasses of American white wheat. Fisher* states, "In certain respects Australian (*i.e.*, the suggested 'Australian Standard White') is definitely a more valuable wheat than 'U.S. Hard White.' In milling properties it is almost without exception the finest wheat that comes to this country." Our "Australian Standard White" class should therefore be regarded as, at least, equivalent to U.S. American "Hard White." This is justification for naming our better quality class "Premier Strong White" and the proposed lower quality class "Soft White." Under the modified f.a.q. system there is no need for six grades for each class as under the American; one is deemed sufficient for the "Premier" class and two for the others.

Probable Objections Answered.

It may be contended in Australia that the suggested system is impracticable because conditions in the harvest field are such that the farmer could not produce, without serious loss, a sample of grain free from unmillable material, and that, in consequence, to market the grain on a "millable wheat" basis

* loc cit.

PRESENT AUSTRALIAN WHEAT MARKETING SYSTEM.

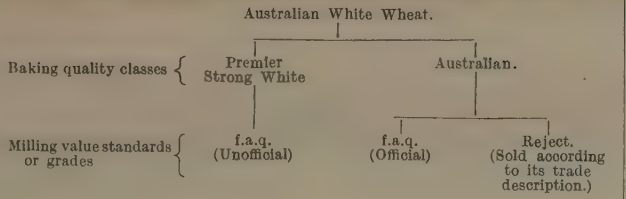


DIAGRAM 1.

PROPOSED AUSTRALIAN WHEAT MARKETING SYSTEM.

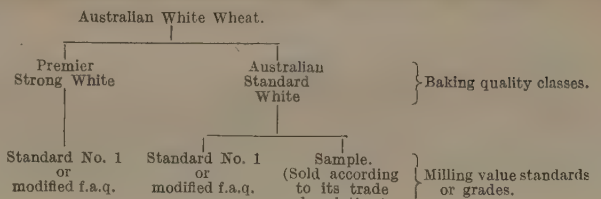

Australian White Wheat.
Premier Strong White
Australian Standard White
Baking quality classes.
Standard No. 1 or modified f.a.q.
Standard No. 1 or modified f.a.q.
Sample. (Sold according to its trade description.)
Milling value standards or grades.

DIAGRAM 2.

A comparison of the features of Diagrams 1 and 2 shows that the principal difference between the proposed and present systems is the modification of the f.a.q. standard or grade.

AMERICAN GRADING WHEAT MARKETING SYSTEM.

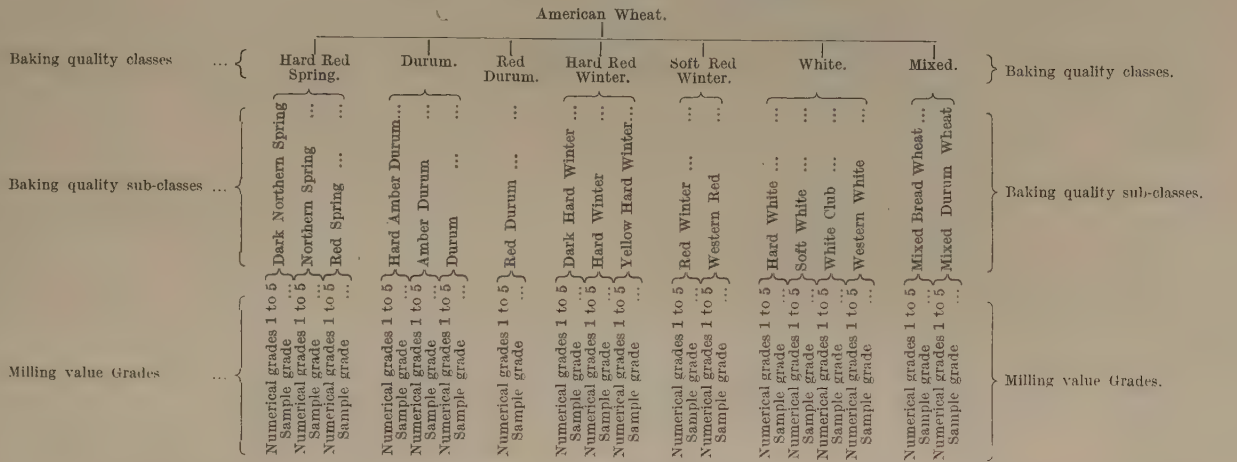


DIAGRAM 3.

A comparison of the features of Diagram 3 with those of Diagram 2 will show that, though there is a great numerical difference in the number of grades in the two systems, the essential features of both are the same.

would involve loss and special and unprofitable work. This contention is based upon a misconception. Under a marketing system on a "millable wheat" basis it is not necessary for the farmer to market his wheat free from unmillable material. The value of the wheat will be assessed on the estimated or determined quantity of millable grain in it. There is, therefore, no need for any alteration in harvesting methods in order to obtain specially cleaned grain.

It may be said, also, that the British buyers will object to the new system, and it is only to be expected that some objections will be raised against any alteration in a trading system which has been in operation for nearly half a century. It is difficult to see on what grounds they can logically object to the modified standard; the type of wheat exported would as at present be the average of all varieties. They would, however, be asked to purchase this on a "millable grain" basis, but what objection can there be to this, seeing that both American and Canadian wheats are brought on a similar basis, and further, that the principles upon which the modified standard is based are those recognised as fundamentally essential for sound assessment? On the other hand, surely no objection can be taken to the suggested abandonment of the bushel weight of commercial wheat as a standard of value, seeing that this same fictitious standard of quality is ignored by their own arbitrators. Nor are they likely to object to accepting the bushel weight of the millable grain as a guide of value when such is recognised and accepted as a feature of the American and Canadian grading system, and further, when short of actual gristing, it is the most reliable guide to its yield of flour.

It is difficult to see how anything can be put forward against the sale and purchase of Australian wheat on a millable grain basis, seeing that wheat from the United States of America, Canada and India is sold and purchased on this basis. On the other hand, it would appear that those representing British buyers are very much in favour of this feature of the suggested standard, for in the report of the "Grain Commissioners for Canada" as far back as 1913 it is stated: "The London Corn Trade Association has made the following proposal with reference to the commercial grades:—That the present commercial grades be standardised on a similar basis to Nos. 1 and 2 Northern, stating the maximum percentage of unsound grains and admixture (*i.e.*, everything that is not wheat) and the minimum percentage of sound wheat, and this proposal is supported by the Liverpool Corn Trade Association and the National Association of British and Irish Millers."

Nor can the overseas buyers very consistently object to the specified bushel weight of millable grain being included as part of contract terms of sale. The bushel weight of the commercial grain is a regular feature of contracts in connection with the sale of Argentine grain and Form 66 of the London Corn Trade Association sets out the conditions under which adjustments in price are made when the actual bushel weight of the wheat varies from that specified in the contract.

It has been pointed out that the wheat trade in the United Kingdom has successfully resisted attempts by the United States of America to make as a condition of their sales that "quality" shall be final at the port of shipment. This does not apply to the present proposal, as there is no suggestion that quality should be final in Australia, nor any attempt to remove from United Kingdom buyers the right to arbitration in case of disputes. The object of the proposed modification is to have a better standard for valuation, and one better understood by all contracting parties, so as to lessen the risk of disputes and reduce as far as is possible the dependence upon individual judgment.

In connection with possible and probable objections from United Kingdom buyers, it is interesting to note the report of the Hon. W. F. Dunn, Minister for Agriculture in New South Wales, who, in 1927, after a visit to England, stated, inter alia: "Finally they (the British authorities) did agree that we should set standards but not too many, say, two or three at most." The present marketing system provides for two standards, viz., "F.A.Q." and "Reject." With the modified f.a.q. standard there would also be two, say, "No. 1" and "Sample." If desirable No. 1 could still be called f.a.q.

It is, however, considered advisable, before the adoption of this or any other proposal for remedying the defects of the present marketing methods, that certain features, e.g., as hereunder, should be discussed in conference with those interested—

(a) Details regarding monetary adjustments for variations in the relative milling value supplied, as compared with that contracted for;

(b) Whether the whole or part of the non-millable material should be paid for, as is the case with Indian contracts 1 and 2 and Egyptian contract 45; and

(c) The character and permissible amounts of foreign matter and damaged grain in the commercial wheat.

It is realised that there is always a reluctance to make a change from an established custom which has been operating for nearly half a century. Callaghan* sums up the position: "If a purely impartial attitude on the part of all concerned with our wheat industry could be obtained there was little doubt that a better system of marketing our wheats on the overseas markets would eventually be adopted. Interests were, however, not impartial and there was very strong opposition to any departure from the f.a.q. system."

VII.—ADVANTAGES OF THE MODIFIED F.A.Q. STANDARD.

Eliminates Inconvenience Due to Delay in Fixing an Annual Standard.

The modified standard is based upon grain characteristics which apply in any season, and not upon those which relate to a specific one. It is, therefore, in effect a permanent standard which does not need fixing annually, and can be used equally well for the first as for the last load of the season. The objection applicable to the f.a.q. standard (that it cannot be fixed early enough to meet the requirements of the trade) does not apply to the suggested modified standard.

Conforms to Requirements of Royal Commission.

The modified standard conforms to the desirable requirements as laid down by the Royal Commission and to which any new standard should conform.

1. It retains the advantage of the f.a.q. standard as set out in Section 244—

(i) It is elastic and valuation by it would reflect the relative milling value of parcels due to the vagaries of the season:

(ii) The suggested standard is so similar to the f.a.q. that it need involve no alteration nor increased cost in the procedure adopted for receiving farmers' wheat at sidings or shipping wheat at ports:

* A. R. C. Callaghan, Ph.D., Principal Roseworthy College, Roseworthy, South Australia: "Garden and Field," 20th March, 1935.

The experience of the W.A. Wheat Inspection Branch in connection with certification of over 90,000,000 bushels export wheat has proved that valuation on a millable grain basis can, if required, be just as simple as the "rough and ready" methods now adopted by workers at present handling the harvest under the present arbitrary systems at the railway sidings. Unskilled workers valuing according to the f.a.q. standard are now required to estimate the percentage of millable grain in a parcel from about 96 per cent. downwards. Under the modified standard they would be required to assess its value from 99 per cent. downwards. Furthermore, it has been found that, since the commencement of this work in 1923-24, by having some mechanical measurement to supplement their judgment these untrained men become more confident in their judgment and their skill improves:

(iii) It is equally simple to operate in respect to the handling of the grain in that there is no need to segregate the wheat at the receiving sidings into several distinct bins or stacks according to a range of standards, as under the American and Canadian systems.

2. It eliminates the disadvantages with trading under the f.a.q. standard as set out in Section 245. Dealing more particularly with subsection ii. it may be stated that valuation on a millable wheat basis will not only discourage farmers from increasing the quantity of unmillable material in grain submitted for market, which the present standard encourages, but it will foster better husbandry for the production of crops freer from weeds, and encourage skilled craftsmanship in the operation of their harvesting machinery, so as to reduce to the practical minimum that unnecessary and unbought material on which transport charges have to be paid. This will provide incentive to improvement for all time.

3. It also avoids that abrupt change likely to lead to disorganisation of the trade referred to in Section 246, for it involves such a slight modification of the machinery of the existing system that the initial difficulties would be small, and, after they were overcome, the change in the methods would be so slight as to be almost imperceptible.

4. It will remove the injustice referred to in Section 247 and which is intensified by the use of the pseudo f.a.q. standard. No fairer method can be found of arriving at the value of the wheat of a farmer, or of a district, than by assessing it according to the amount of millable grain it contains and the bushel weight of that grain.

5. It meets the requirements of a new scheme as set out in section 248. Valuation on a "millable" or "clean" wheat basis meets in the best possible manner the consideration of cleanliness, whilst regard for the "milling value" of the grain is provided by requiring that its bushel weight shall be specified. Careful consideration has also been given to the requirements of overseas buyers, as represented by the London Corn Trade Association as outlined in their contracts (over 70) for trading with the wheat countries of the world.

6. The Royal Commission recommended in Section 702, subsection xiii.: "That the plant breeders in Australia make every endeavour to produce new varieties of wheat which have the quality of 'strength' in addition to the other favourable attributes characteristic of Australian varieties." The modified standard suggested in lieu of the f.a.q. will have no influence in that direction. The motive for its introduction is to improve the marketing conditions for any class

of wheat irrespective of its baking quality. The suggested elimination, from the standard white class, of varieties according to their baking quality, and particularly the exclusion from the main standard class of varieties below a specified baking quality, will achieve, however, the object underlying the recommendation of the Royal Commission.

The proposed change is evolutionary not revolutionary. Just as the f.a.q. system supplanted a less suitable one, so it is believed that, because of our greater expansion, it is now desirable that our present arbitrary f.a.q. standard, which has served its turn, should give place to a more modern system which is more in keeping with the march of standardisation, and which will bring the Australian system in line with the other great wheat exporting countries of the world.

Of all those interested in the wheat industry this matter is of most moment to the farmer, but it is also of national importance. In the national interest no less than in the farmers' it is, therefore, the obvious duty of all to smooth away the initial difficulties rather than place obstacles, slight though they be, in the way of the change. The magnitude of the losses direct and indirect, due to our unsound wheat trading standards, demands that they be changed and requires that all wheat interests co-operate whole-heartedly to establish an equitable system.

AGRICULTURAL PROBLEMS

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and names of Advisers are as follows:—Albany, A. C. Vaughan; Bridgetown, A. Flintoff; Bunbury, M. Cullity; Denmark, V. Cardon; Geraldton, G. L. Throssell, Government Buildings; Gosnells, R. C. Owen; Harvey, D. L. Breen (Fruit) and C. Giles (Dairying); Katanning, A. S. Wild; Manjimup, J. Ireland; Mundaring, V. Cahill; Northam, F. L. Shier; Northcliffe, A. Sharp; Vasse, J. M. Nelson.

BORDEAUX MIXTURE.*

THE WORLD'S MOST COMMONLY USED FUNGICIDE.

Simple Directions for its Preparation in either Small or Large Quantities.

H. A. Jaques Pittman, B.A., B.Sc.Agr. (Hons.), Dip. Ed.,
Plant Pathologist.

INTRODUCTORY.

History records the fact that it was in, or about, the year 1585, that Sir Walter Raleigh introduced into Great Britain, from its native home in Chili and Peru, the plant which we now know as the potato.

For many years after potatoes were first introduced into Great Britain, their cultivation appears to have been attended by no great difficulty. Between the years of 1830 and 1840, however, there was introduced, by accident, into Europe, from South America, a disease which gradually increased in severity and rendered the growth of the crop ever more and more precarious.

THE COMING OF "IRISH BLIGHT."

In 1845 a terrible wave of this epidemic disease swept the potato fields from Norway to the town of Bordeaux in France, and from Poland to Canada, reaching in several countries to the height of a national calamity.‡ In Ireland the disease rapidly developed to an intensity unequalled in any other country; so much so that ever since 1845 this dreaded scourge has been known all over the world as "Irish Blight."

Hundreds of thousands of people died of starvation, great political disturbances ensued, and there commenced a great exodus from the "Emerald Isle" to the United States of America and elsewhere, as a direct result of the consequent unhappy conditions.

DISCOVERY OF BORDEAUX MIXTURE.

In 1882, almost 40 years after the outbreak of Irish Blight in the potato crops of Great Britain, a closely related disease, now known as "downy mildew," was found to be causing enormous havoc on the *grape* vines of France and other parts of Europe. Thousands of acres of grape vines were completely defoliated, and enormous numbers of bunches were destroyed in a few weeks after the disease broke out.

A French scientist, by the name of Millardet, who was investigating the trouble in 1882, was struck by the fact that certain vines in the Bordeaux district of France continued to retain their leaves uninjured, although surrounded on all sides by ruined vines.

Attributing this strange phenomenon to some treatment whereby they had been able to resist attack, he found, on enquiry from the vignerons concerned, that it was their practice to daub the leaves of these particular vines with verdigris, or with a mixture of lime and copper sulphate, to make them look as if they had been poisoned.

* Revised from the article of the same name which appeared in the December issue of this Journal for 1932, pp. 542-554.

‡ Butler, E. J.—"Fungi and Disease in Plants," p. 278, Thacker, Spink & Co., Calcutta and Simla, 1918.

In this way, the boys of the district and other passers-by, thinking the bunches of grapes below the leaves would be similarly treated, would not touch the fruit for fear of being poisoned. Millardet followed up this slender clue, and in 1885 was able to announce to the world the successful use of a lime and copper sulphate mixture as a fungicide against "downy mildew" of grapes.

The value of the new fungicide (which was called "Bordeaux Mixture" from the locality in which it originated) was rapidly established, and improvement in the original formula followed at once.

PRESENT POPULARITY OF BORDEAUX MIXTURE.

At the present time, Home-made Bordeaux Mixture is the most valuable and economical spray material for the control of most plant diseases of a parasitic nature. Although not used absolutely exclusively by growers, it is used to a much greater extent than all the other fungicides combined. It is remarkably effective in preventing such diseases as Irish Blight of potatoes, and had its method of preparation been known in 1845, when the epidemics of this disease broke out with such disastrous consequences in Europe, most of the trouble could have been prevented. Dr. E. J. Butler, Director of the Imperial Mycological Institute, Kew Gardens, London, says (page 285, *Loc. cit.*): "Spraying to check Irish Blight of potatoes is probably more widely employed and gives more satisfactory results than with any other field crop disease. Not only is it a routine practice in the intensive cultivation of such favoured places as the Island of Jersey, where high profits permit of lavish expenditure, but in the poverty-stricken districts of the West of Ireland, nearly 10,000 spraying outfits were supplied by the Agricultural Department to the potato growers in the six years ending 1914."

In Western Australia, owing to the hot dry weather which prevails during the greater part of the year, Irish Blight of potatoes has never been of any great importance, but we have here a number of very serious diseases of plants, such as Anthracnose of grapes (*Gloeosporium ampelophagum*), Anthracnose of navel oranges (*Colletotrichum gloeosporioides*), Brown rot of citrus (*Phytophthora hibernalis* and *P. citrophthora*), early blight of potatoes (*Macrosporium solani*), late blight of celery (*Septoria apii*), black spot of pears (*Venturia pyrina*), shot hole of apricots (*Clasterosporium carpophilum*), Septoria leaf spot of tomatoes (*Septoria lycopersici*) and so on, in the control of which it is exceedingly valuable.

GOOD QUALITIES OF BORDEAUX MIXTURE.

The great and lasting popularity of Bordeaux Mixture as a spray for the vine, and for most orchard, vegetable and flower garden plants, may be attributed very largely to its following good qualities:—

1. When properly prepared, it is remarkably adhesive to most types of stems, fruits and foliage. After it has once dried on the plant it can only be slowly removed by rains, dews or other climatic influences.
2. It has a very high efficiency in preventing infection of the above-ground parts of plants by most types of fungi.
3. The cost of the ingredients required to make a large volume of spray is relatively low.
4. When used at the ordinary strength, it is quite harmless to most types of cultivated plants.
5. It has a decidedly stimulating effect on the growth of many plant species, quite apart from its fungicidal action. Outstanding examples of this stimulating effect are to be seen in potato crops and citrus and pear trees.
6. It is quite simple to prepare and safe to handle.

DRAWBACKS TO THE USE OF BORDEAUX MIXTURE.

1. Its main disadvantage is that *bluestone (copper sulphate) which is one of the essential ingredients, will speedily corrode iron or steel, and all the other commonly-used metals, or alloys, except copper, brass or bronze.* This difficulty is usually overcome, in practice, by dissolving the bluestone in wooden tubs or casks, and by using bronze, brass, or porcelain-lined spraying equipment and accessories. *On a small household scale the copper sulphate may be dissolved in copper, brass, bronze, glass, enamel or earthenware vessels.* Metal vessels such as galvanised iron buckets, kerosene tins, 40-gallon petrol or oil drums, etc., may be rendered suitable by first painting with several coats of "Botanite" or some other suitable anti-corrosive paint.

2. Another disadvantage is that *Bordeaux Mixture has been found very apt to cause injury to the leaves and fruit of apple trees, and most kinds of stone-fruit trees (especially peaches and Japanese plums) if applied in the spring or summer after the "spur-bursting" or "bud bursting" stage.* To overcome this disability in the case of apples, only very weak strengths and an excess of lime are recommended from the "pinking" stage onwards if it is necessary, for any reason, to use Bordeaux Mixture on apple trees in growth, or weak "lime sulphur" may be substituted for the later sprays.

There is no difficulty in this State so far as Bordeaux injury to *stone fruits* is concerned, inasmuch as all the fungus diseases which occur here, as yet, on such plants, can be readily controlled by spraying with Bordeaux Mixture in the winter, or just as the buds are bursting in the spring, or, in addition, as the leaves are falling from the trees in the autumn, as the case may be. If these sprayings are carried out efficiently, there is, at present, no necessity for the summer spraying of stone fruits in this State. (See Leaflet No. 426.)

Apricots are fairly resistant to Bordeaux injury and may be safely sprayed with the 3—4—50 strength when the fruit is well set to half-grown, if necessitated by the seriousness of "Shot-hole" or "green rot." (See Leaflet No. 426.)

In connection with the lessening of spray injury by Bordeaux Mixture, it should be remembered that, *Bordeaux Mixture should only be applied during warm, dry weather,* as injury is most likely to occur if the spray is used during, or just preceding, rainy or dull, humid, slow-drying climatic conditions. The addition of an efficient spreader (see section on spreaders near the end of this article) will also tend to lessen the danger of russetting the fruit or causing leaf injury. Further information *re* using Bordeaux Mixture as a spray for apples after the "spur-bursting" stage will be found on pages 254-263 of the June issue of this "Journal" for 1930, or on pages 17-23 of Department of Agriculture Bulletin No. 306, entitled "Black Spot or Scab of Apples and Pears in Western Australia."

3. The only remaining serious objection to the use of Bordeaux Mixture is that *it imparts a bluish colouration to sprayed plants,* so that it is sometimes considered unsightly on ornamental or flower-garden subjects, and it cannot, of course, be used on produce just prior to marketing. For this latter purpose, ammoniacal copper carbonate or very dilute Burgundy mixture (1-1¼-50) should be used instead. (Ammoniacal copper carbonate is made by mixing 5 ounces basic copper carbonate in a non-corrosible container with sufficient water to make a thick paste. Then add 3 pints strong ammonia—26° Beaumé—to dissolve the paste. Then add a little more copper carbonate with frequent stirring (up to about 1 oz.) till no more can be dissolved. Then dilute with water to make 50 gallons.)

4. Evidence is accumulating that *Bordeaux Mixture may increase drought injury of certain plants grown under very dry conditions* by increasing the transpiration ratio, that is, the ratio of water loss through the leaves to dry matter built up. Under such circumstances, however, fungal troubles should not be of sufficient importance to necessitate spraying.

HOME PREPARATION OF BORDEAUX MIXTURE ADVISABLE.

Many farmers, orchardists, vignerons, vegetable-growers and home-gardeners in this State are under the erroneous impression that Bordeaux Mixture is difficult to prepare, and, in consequence, obtain their copper fungicide as a powder already mixed. Numerous experiments the world over have indicated that ready-made so-called "Bordeaux" Mixtures are not as effective, or as adhesive, as the freshly-prepared, properly-made, home-made mixture. Considerable burning of fruit and foliage has sometimes followed the use of commercial so-called "Bordeaux" powders in this State. Mason, in his "Spraying, Dusting and Fumigating of Plants" (3), writes, "Bordeaux Mixture is the one spray which, if used in any considerable quantities, should always be made on the farm, the commercial forms being of less value than the freshly-made products."

USE OF LIME ESSENTIAL FOR THE PREPARATION OF TRUE BORDEAUX SPRAYS.

As already indicated, Bordeaux Mixture takes its name from the district in France where it was first discovered. *True Bordeaux Mixture is always made from bluestone and quick lime* (or, alternatively, hydrated lime) in a manner more or less as given below. Owing to the fact that quick lime rapidly deteriorates when in contact with the air, its use in ready-made powders, which may be kept in store for long periods before being used, is a practical impossibility. Consequently in commercial powders washing soda is generally used. Such substances are not properly called "Bordeaux" mixtures, but should be known as "Burgundy" mixtures, after the area in France where the bluestone-soda formula was first used.

Burgundy mixtures are much more apt to "burn" plant tissues than true Bordeaux sprays. Whereas increasing the amount of lime in a Bordeaux Mixture decreases its likelihood of causing injury, increasing the amount of soda in a Burgundy mixture, above a certain point, rapidly increases its "burning" properties.

Burgundy mixture has now very largely gone out of use on account of its caustic properties, although it was formerly very much used in some parts of the world as a substitute for Bordeaux.

Many gowers object to the preparation of Bordeaux Mixture on account of the difficulty of obtaining quick lime in the small quantities which they may only require at any one time. This source of annoyance can very easily be avoided by the use of "stock solutions" of quick lime as explained later on in this article.

FORMULAE FOR MAKING BORDEAUX MIXTURE.

The formula in most general use, at the present time, for most vegetable, flower-garden and fruit plants, is that known as "4—4—50." *This means* 4 *lbs. of bluestone and* 4 *lbs. of "freshly-burnt," "stone," or "quick" lime to every* 50 *gallons of the mixture.* 4—4—40 (i.e., 1—1—10) is another commonly used formula.

The standard formula may be varied, so as to allow for a greater or less proportion of bluestone to lime, as experience indicates to be necessary, for the control of a particular disease, and the avoidance of spray injury to the species of

plant concerned. Thus 6—6—40 is used in Western Australia for the "bud-bursting," "pre-blossoming" and "fruit set" sprayings of the vine against "Anthracnose" (*Gloeosporium ampelophagum*), but later sprayings, if required, are given at 6—6—50, and the writer considers 2—5—50 all that would be permissible or necessary here for the summer spraying of apples against "black spot," should that disease ever become established in this State (see Department of Agriculture Bulletin No. 306).

THE FIRST FIGURE IN THE FORMULA MEANS LBS. OF BLUESTONE.

In all formulae for the preparation of Bordeaux Mixture the *first* figure given is the number of pounds of bluestone, the second figure is the number of pounds of "freshly-burnt," "quick" or "stone" lime, and the final figure indicates the full number of gallons to which the mixture must be made up with water prior to spraying.

GENERAL DIRECTIONS FOR PREPARING BORDEAUX MIXTURE.

Assuming, for sake of illustration, that 4—4—40 Bordeaux Mixture is to be prepared, the procedure would be as follows:—

Firstly, dissolve the total amount of bluestone, *i.e.* 4 lbs., in one half the total amount of water, that is, in 20 gallons of water, in a suitable container. (See earlier in this article.)

Secondly, slake the total amount of best quality freshly burnt lime, *i.e.*, 4 lbs., *in a little water in another container of any kind*, and, when slaking is completed, add additional water until 20 gallons of "milk of lime," as it is called, is formed.

Thirdly, pour the twenty gallons of dilute bluestone solution and the twenty gallons of dilute "milk of lime" simultaneously through a fine brass or bronze sieve, into a third container of suitable character, which may be the spray outfit, so as to make a total of 40 gallons. The mixture should be kept well agitated as the two liquids run together. We have now 40 gallons of 4—4—40 strength Bordeaux Mixture, which should be kept well agitated and be sprayed on the plants requiring same without any loss of time. If for any reason the spray has to be left standing unused for a short time, add one heaping tablespoonful of table sugar for every 100 gallons of spray.

An alternative method to that indicated above is to dissolve the total amount of bluestone which is required, in a volume of water which is equal to about three-quarters of the total volume of the spray to be made. (This may be done in the spray tank.)

The total amount of quick lime which is required is then slaked in a little water until slaking is complete, when the remainder of the water which is required to give the full amount of spray is then added to it.

The agitator of the spray outfit is then set working in the diluted bluestone solution, and the milk of lime thoroughly stirred and run through a sieve into the agitated bluestone.

Any deficiency of water is then run through the sieve to make up the full volume of the spray which it was intended to make.

This method does not give as good a Bordeaux Mixture as does the first method, but it has the advantage of economising in the apparatus required.

DIRECTIONS FOR PREPARING BORDEAUX MIXTURE IN SMALL QUANTITIES FOR HOME GARDENS.

A small quantity of Bordeaux Mixture of 4–4–40 formula can be prepared by taking:—

(1) 4 ozs. bluestone,

(2) 4 ozs. "freshly burnt," "stone," or "quick" lime,
and making up to a final volume of 2½ gallons as indicated below*:—

a. Dissolve the 4 ozs. of bluestone in a wooden tub or wooden barrel, or a copper, bronze, brass, glass or earthenware vessel, using 1¼ gallons of water. The bluestone may be dissolved by suspending it overnight in the water in a piece of hessian, bagging, or linen, from a stick placed across the mouth of the receptacle; or by heating the water and pouring it over the bluestone in the bottom of the receptacle, if the mixture is required in a hurry. Bluestone "fines" or "snow" may be used with advantage instead of the usual large crystals, as they dissolve quite readily in cold water, on gentle agitation.

b. Slake the 4 ozs. of quick-lime, which must be quite fresh and of good quality, in another container, by adding water a little at a time. A small wooden cask is convenient, but, unlike the bluestone, an iron vessel such as a clean empty kerosene tin may be used in which to slake the lime. **When slaked, make up to 1¼ gallons with water.** This suspension and partial solution of lime in water is known as "milk of lime."

c. Pour the two liquids simultaneously through a copper, brass or bronze wire strainer into the spray outfit, or into a wooden or other non-corrosible container, and, after seeing that the volume is exactly two and a half gallons, use immediately.

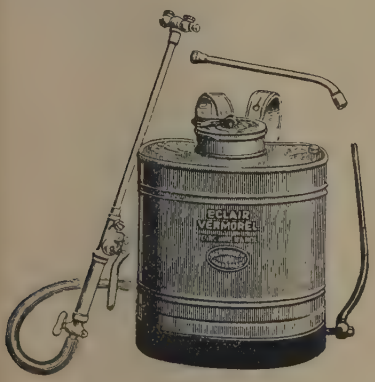


Fig. 1.—A type of knapsack sprayer suitable for use on small areas. Note the Spring Lever Tap (Trigger Grip Control) with which the spray can be released or stopped instantly. The liquid capacity is 3¼ gallons. Such a machine can be obtained with a copper tank for spraying with Bordeaux Mixture; made of special brass alloy for spraying, in addition, with Lime Sulphur or similar sulphides; or with all parts lead-coated for spraying with acids such as Sulphuric Acid, as used for the control of "anthracnose" of grapes, etc.

(After "Vermorel Eclair Export Catalogue," No. 22, 1932.)

An alternative method is to first strain the milk of lime into the spray outfit through a piece of bagging to remove any gritty particles or lumps which might clog the sprayer, and then pour in the bluestone solution, keeping the milk of lime well agitated while doing so. See that the final volume is correct and commence to spray immediately.

* If approximately 4-4-50 Bordeaux Mixture (actually 4-4-48) is to be made, the final volume will be three (3) gallons instead of two and a half (2½). In this case the same amounts of bluestone and quick lime are required, but each amount should be "dissolved" in 1½ gallons instead of 1¼.

The bluestone solution and the milk of lime can be kept indefinitely, so long as they are kept separate and any evaporated water is replaced to each before using; but once they have been added to each other the spraying must be commenced immediately and continued until all the spray is used up, as Bordeaux mixture soon deteriorates if left standing without constant agitation after being made up.

Never mix the solid lime and bluestone together before adding the water. The more dilute each constituent is before meeting the other, the better.

STOCK SOLUTIONS AS A MEANS OF REMOVING THE DRUDGERY FROM THE FREQUENT PREPARATION OF BORDEAUX MIXTURE.

It rarely happens that a single spraying is sufficient to control a disease in plants. Even in those cases where a single spraying carried out at the right time does suffice, as with "Shot-hole" of stone fruits in many places, or "Peach Leaf Curl," the orchardist usually finds that the different varieties are not all ready for spraying at the same time. This usually means that the spraying period is protracted and the grower becomes impatient at having to continually make up "from scratch" a fresh lot of spray. Frequently, also, a grower finds, on going to use his quicklime, that it has become air-slaked, with the result that a new lot of quicklime must be ordered for delivery in a hurry. This often causes fraying of tempers, and there is always the possibility of a lot of damage being done by disease, in the meantime, before the new lot arrives. A certain amount may be used out of the new consignment, and again deterioration may take place by the time the remainder is required.

Difficulties of the above nature may readily be avoided if the growers will appreciate the following facts:—

Although, when once prepared, Bordeaux Mixture must be used immediately, the separate ingredients, i.e., the bluestone and the lime, can be kept in concentrated form in water for very long periods without deterioration taking place, and ready for use at a moment's notice.

METHOD OF MAKING UP STOCK SOLUTIONS OF BLUESTONE AND QUICK LIME WHEN ONLY VERY SMALL QUANTITIES OF BORDEAUX MIXTURE WILL BE USED AT ANY ONE TIME.

Where Bordeaux Mixture is required for use in small flower-gardens or small-scale vegetable gardens, it can most conveniently be prepared in quantities of about 2½ or 3 gallons, as indicated above.

A good plan is to weigh out on the one occasion a large number of batches of bluestone "fines" or "snow," each batch weighing 4 ounces. Each 4-ounce lot is then dissolved in a bottle containing about a quart of water.

As soon as possible after purchase, the "quick lime" should be broken down with a hammer, taking care to avoid injury to the eyes from flying particles. The broken pieces are then weighed out into units of 4 ounces each. Each unit of 4 ounces is then separately slaked, with a minimum of water, in a metal container. When it has cooled down somewhat, each 4-ounce lot is run through a metal funnel into a large bottle containing about 2 inches of water, and additional water is added through the funnel until the bottle is almost full.

Both the bluestone and quick lime "solutions" in bottles can now be stored indefinitely until required for use in making up the Bordeaux Mixture. It is desirable that the bottles containing the lime should be corked, but apart from the possibility of the bottles being upset this is not important in the case of the bluestone.

SLAKING OF QUICK LIME IN A METAL FUNNEL.

A very satisfactory way of slaking the 4-ounce quantities of broken quick lime is to take a cheap tin 6-inch diameter funnel with a spout of diameter small enough to pass easily into the neck of a "six-to-the-gallon" or quart bottle. A rubber stopper is used to temporarily block up the aperture at the top of the spout. To provide a means of withdrawing the stopper when required, a piece of wire should be fixed through its centre. The broken quick lime is packed in the funnel round the wire, and on top of the rubber stopper, in lots of 4 ounces at a time. The lime is slaked in the funnel with a small quantity of water, and when slaking is complete the rubber stopper is gently raised from the top of the spout by means of the wire. This allows the slaked lime to run, with the help of additional water, into the bottle below. Two inches or so of water placed in the bottle before commencing to slake the lime will prevent the cracking of the glass as the hot slaked lime runs into it. A piece of fine wire bent over the neck of the bottle, so as to make an air space between the side of the bottle and the spout of the funnel, will allow the slaked lime to enter the bottle and the air to escape without trouble. (See Fig. 2 for diagrammatic representation of the above-described technique.)

To make a small quantity of Bordeaux Mixture of 4-4-40 strength, all that now remains is to take one bottle of bluestone concentrate, and one bottle of lime concentrate, pour each into a separate container and add sufficient water to bring both solutions to 1¼ gallons each.

The lime should be thoroughly shaken before pouring from the bottle so as to incorporate the sediment with the clear liquid above it.

The diluted bluestone and diluted quick lime "solutions" are then poured simultaneously together, and the Bordeaux Mixture is ready for use.

PREPARATION OF STOCK SOLUTIONS OF BLUESTONE AND QUICK LIME WHEN LARGE QUANTITIES OF BORDEAUX MIXTURE ARE TO BE USED AT ONE TIME.

Where large quantities of Bordeaux Mixture will be required at any one time, the best procedure for making the stock solutions is as follows:—

1. Work out approximately how much bluestone and lime will be required to carry out your spray programme. (It usually takes about two gallons of liquid to spray a well-grown apple, stone-fruit or citrus trees in this State for the control of fungous diseases, and anything from 100 to 150 gallons to cover one acre of vegetable crops such as almost fully-grown potatoes. Various factors will tend, however, to vary the amount required, and the experienced grower will know best just how much he will need for a particular area or job.)

2. Then dissolve the bluestone in water in wooden casks or other non-corrosible containers at the rate of 1 lb. to every gallon of water.

This can best be done by suspending the bluestone overnight, in a sugar bag or cut-down chaff bag, from a stick placed across the mouth of the cask and so arranged that the bluestone is just beneath the surface of the water. If wanted in a hurry, the crystals can be fairly readily dissolved by pouring hot water over them at the rate of about 1 gallon of hot water to every 3 lbs. of bluestone. Bluestone "fines" or "snow," of course, dissolves readily in cold water.

3. Slake the "freshly burnt," "stone" or "quick" lime in other containers at the same rate as the bluestone, i.e., so that each gallon of the concentrate contains in it one pound of quick-lime. This is done by adding water, a

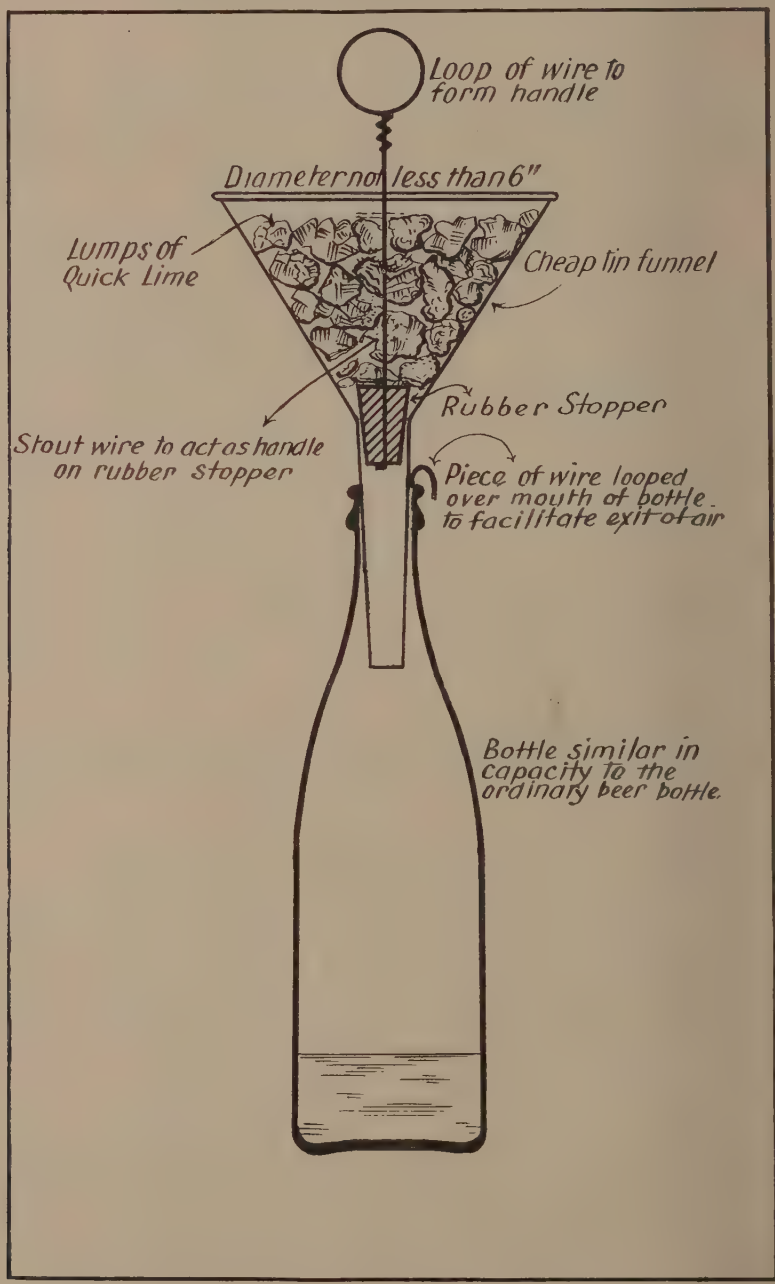

Loop of wire to form handle
Diameter not less than 6"
Lumps of Quick Lime
Cheap tin funnel
Rubber Stopper
Stout wire to act as handle on rubber stopper
Piece of wire looped over mouth of bottle to facilitate exit of air
Bottle similar in capacity to the ordinary beer bottle.

Fig. 2.—Diagrammatic representation of method of slaking quick lime in small quantities, such as 4-ounce lots, in a metal funnel, prior to running into "six-to-a-gallon," or quart, bottles, for storage purposes. For full explanation of the technique see text. A cork may be used instead of a rubber stopper, but is not so satisfactory, as it is attacked by the caustic properties of the hot lime.

(Drawing by courtesy of Chief Draughtsman, Lands Department.)

little at a time, until all the lime is slaked, and then bringing the water level up to the required height in the containers. Iron vessels are quite suitable to make the lime concentrate in, but wooden casks are generally used.

The New South Wales Department of Agriculture has carried out a series of experiments and finds that **lime may be stored under water even for periods of twelve months. There is a slight decrease in the effective lime amounting to about $^3/_4$ per cent., but this decrease is so slight as to be negligible (4).**

Only a little of the lime actually goes into solution, the major portion eventually sinking to the bottom of the container. The sediment must, however, be stirred up into the overlying water before the lime concentrate is used for spraying purposes.

To check evaporation, a few drops of lubricating oil (not spraying oil) may be placed on the surface of each concentrate and a mark should be made at the surface of each lot when it is finished with for the time being, so that any water which has evaporated may be replaced before using it again. Covers should also be placed over concentrates to prevent animals or children interfering with them, and they should be protected from rain, dust-storms, etc., when not in use.

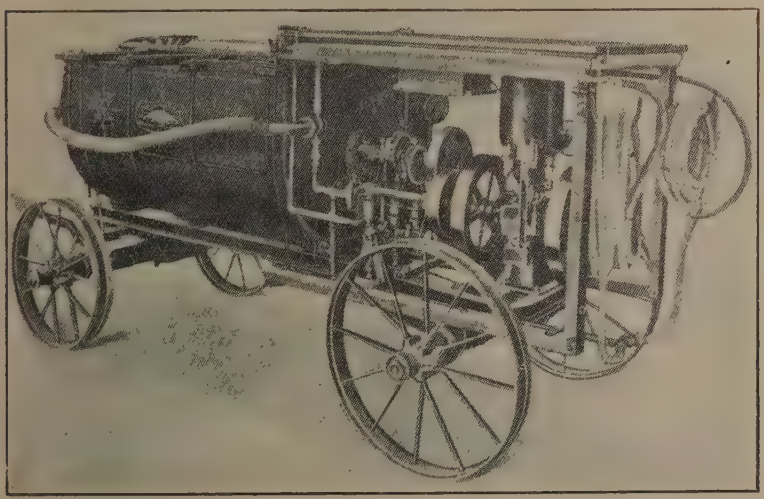


Fig. 3.—A power spray of American make, especially suitable for orchard work. The spray tank holds 200 gallons.

(After W. J. Allen, in "Spraying"—"Farmers' Bulletin," No. 72, 2nd edit., N.S.W. Dept. Agric., June, 1915.)

PROCEDURE TO BE FOLLOWED WHEN MAKING THE BORDEAUX MIXTURE FROM THE CONCENTRATES.

There are two alternative methods which may be used for making the Bordeaux Mixture from the concentrates.

The second method is the simpler, but does not give quite as good a spray mixture as the first. The first method gives the best possible mixture, but involves the use of a little more equipment than the second.

First Method: To be used, wherever possible, in preference to the second. (See Fig. 4.)

This method is preferable to the second, but necessitates two extra containers. The underlying principle is that the ideal Bordeaux Mixture can only be prepared if both the lime and bluestone concentrates are diluted as much as possible (i.e., in each case to a volume equal to half the total volume of the Bordeaux to be made) before running them together simultaneously through the brass, bronze or copper wire strainer into the spray tank.

Stir the lime concentrate thoroughly, being especially particular at the sides and corners of the container, so as to get a uniform distribution of the lime in the water, and, when thoroughly well mixed, dip out the full amount required, remembering that, when well stirred, each gallon of lime concentrate contains the equivalent of one pound of quick-lime. Pour the lime into the lime-dilution vessel through a piece of bagging, or, better still, a fine wire sieve containing 18-20 meshes to the inch, to remove any gritty or coarse particles which might tend to block up the spraying equipment. (A copper, brass or bronze wire sieve is the best, as it can then also be used for the bluestone when the time comes.)

Proceed similarly with the concentrated bluestone, and finally run the two diluted ingredients simultaneously through a suitable strainer into the spray tank, keeping the resultant mixture well stirred until all is used up.

In the case of the 4–4–50 formula, for example, 4 gallons of lime concentrate, after thorough stirring, are diluted to 25 gallons, with water, in a second wooden barrel or other suitable container. Four gallons of bluestone concentrate are similarly diluted in another wooden container to 25 gallons. Both lots of the diluted materials are then run together, simultaneously, through the non-corrosible sieve into the spray tank, by means of taps and rubber hoses let into the bottoms of the dilution vessels. (See Fig. 4.)

Second Method (this does not produce as good a Bordeaux Mixture as does the first method):

a. Stir the lime concentrate thoroughly, being especially particular at the sides and corners of the container, so as to get a uniform distribution of the lime in the water, and, when thoroughly well mixed, dip out the full amount required, remembering that, when well stirred, each gallon of lime concentrate contains the equivalent of one pound of quick-lime. Pour the lime into the spray tank through a piece of bagging, or, better still, a fine wire sieve containing 18-20 meshes to the inch, to remove any gritty or coarse particles which might tend to block up the spraying equipment. (A copper, brass or bronze wire sieve is the best, as it can then also be used for the bluestone when the time comes.)

b. After sieving the lime concentrate into the spray tank, add water to the tank until it contains a volume of water equal to about three-quarters of the total volume of spray to be made, i.e., in the specific case under consideration, fill up the tank to about 40 gallons.

c. Set the agitator going and strain in the required amount of bluestone concentrate, remembering again that each gallon of bluestone concentrate contains 1 lb. of solid bluestone. (There should really be no need to sieve the bluestone solution, except that small pieces of straw, etc., which might block up the sprayer, might have been blown into the solution during the storage period.)

d. We have now arrived at the stage where about 44 gallons of liquid, containing a light-blue flocculent precipitate, are in the spray tank. If a spreader is to be used, it should now be added, and then the volume should finally be brought up to 50 gallons with the necessary amount of water.

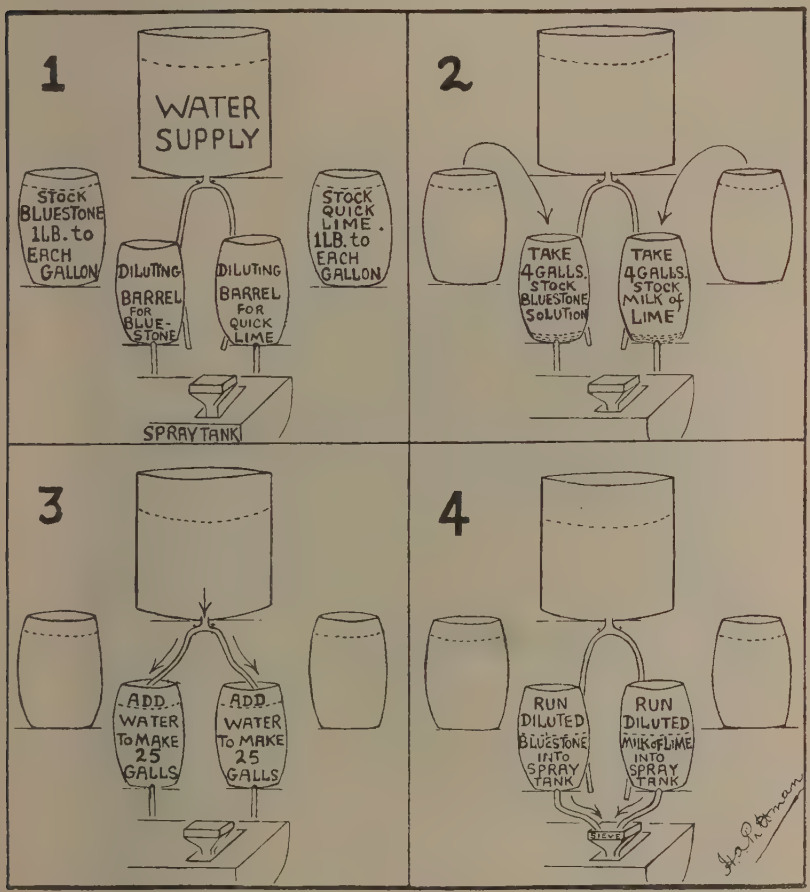

1
WATER SUPPLY
STOCK BLUESTONE 1LB. to EACH GALLON
DILUTING BARREL FOR BLUE-STONE
DILUTING BARREL FOR QUICK LIME
STOCK QUICK LIME. 1LB. to EACH GALLON
SPRAY TANK
2
TAKE 4 GALLS. STOCK BLUESTONE SOLUTION
TAKE 4 GALLS. STOCK MILK of LIME
3
ADD WATER TO MAKE 25 GALLS
ADD WATER TO MAKE 25 GALLS
4
RUN DILUTED BLUESTONE INTO SPRAY TANK
RUN DILUTED MILK of LIME INTO SPRAY TANK
SIEVE

Fig. 4.—Diagrammatic representation of method of preparing 4-4-50 Bordeaux Mixture from Stock Solutions of Bluestone and of Lime. The Stock Solution of Bluestone is made by dissolving 1 lb. of Bluestone to each gallon of water, and the Stock Solution of Quicklime by slaking, in a separate container, 1 lb. Quicklime for each gallon of "milk of lime" required, in the manner indicated in the text.

(1.) Apparatus and solutions ready for preparing the Bordeaux.

(2.) Four gallons of concentrated bluestone solution have been placed in one of the dilution barrels and four gallons of concentrated "milk of lime" in the other.

(3.) Water is added to each dilution barrel to bring the volume in each to 25 gallons.

(4.) The diluted bluestone and diluted lime are then run simultaneously into the spray tank through a brass, bronze, or copper wire strainer having 18-20 meshes to the linear inch. The agitator is kept running during this process.

(*Drawing by Author. Not to scale and details of taps, etc., have been omitted.*)

THE MIXTURE MUST BE USED IMMEDIATELY IT IS PREPARED.

Use the Bordeaux Mixture immediately it is prepared, if possible, but, if for any unforeseen reason, it has to be kept standing for some time before use, first add to it one-eighth of an ounce of table sugar (cane-sugar) for every pound of bluestone which has been used. In the example being considered, $\frac{1}{8}$ oz. x 4 = $\frac{1}{2}$ oz. of table sugar would need to be used. The table sugar prevents the deterioration of the flocculent (flake-like) blue precipitate to which the

Bordeaux Mixture owes its desirable qualities. (One heaping tablespoonful of table sugar equals one ounce. This would be the quantity required for 100 gallons of 4-4-50 Bordeaux Mixture.)

Fig. 5.—A good type of elevated stand for the preparation of Bordeaux Mixture and the convenient filling of the spray outfit. Stock solutions may be diluted in the two central barrels on the lower platform, and run into the spray tank through a large pipe and hose extending out from between the barrels. The stock solutions of copper sulphate (bluestone) and lime may be kept in other barrels on the lower platform, or in two large barrels on the top platform. It is better if the top platform is reserved for the water supply, which may be held in large barrels or an iron tank. If an iron tank (galvanised or otherwise) is used to hold the water supply, care should be taken that it is not splashed with the bluestone solution, or, better still, it should be well protected on the outside with "Botanite" or good quality paint or tar to prevent corrosion.

(*After Mason, "Spraying, Dusting and Fumigating of Plants."*)

AN ELEVATED STAND VERY CONVENIENT.

For the most convenient preparation of Bordeaux Mixture a wooden stand should be erected handy to an overhead water tank or other source of water supply. The vessels to hold the concentrates and the diluted ingredients are placed on the stand, which is built of such height that the tank on the spray outfit can be conveniently filled by the force of gravity. In this way all heavy lifting is obviated, the only liquids requiring to be lifted being the small quantities of concentrates required for every 50 gallons of mixture. Instead of a wooden stand a vertical cut through a hillside or earth bank may be made to allow the spray equipment to pull up in front of, but below the level of, the mixing site.

PURITY OF THE INGREDIENTS ESSENTIAL.

The bluestone bought should be of at least 98 per cent. purity. It is usually bought in the form of large dark-blue crystals, and should not contain any appreciable amount of the greenish-coloured sulphate of iron which is sometimes met with in commercial samples of bluestone. It may be tested by dissolving a small quantity in water, diluting this with extra water in a tumbler until it becomes a light-blue colour, adding a little ammonia and then stirring well. A pale-blue precipitate of copper hydrate is first formed, but this quickly dissolves, if enough ammonia is present, to give a very intense violet-blue colour. The formation of a reddish-coloured precipitate or sediment indicates the presence of iron.

Fig. 6.—Desirable type of power-sprayer for large orchard. Note the sturdy steel frame, underslung tank, large wide-tyred rear wheels and small front wheels which will run under the frame, making short turns possible. There is sufficient capacity to operate two spray "guns" at high pressure.

(*After Mason, "Spraying, Dusting and Fumigating of Plants."*)

THE LIME MUST BE FRESHLY BURNT.

With reference to the lime used for the preparation of Bordeaux Mixture, it is of extreme importance that the lime should be freshly burnt. To test whether this is so, or to see if it has become to any extent water- or air-slaked, a few lumps should be placed in a heap and sprinkled with water. Freshly-burnt lime will become very hot, give off a quantity of steam, gradually fall to pieces and crumble to a fine white powder. Some lime will not do this readily with cold water, but may do so if hot water is used. If the lime does not get hot enough to give off steam, even with hot water, it is unsuitable.

Water-slaked lime may be used, provided that it has only been slaked a day or two at the most, and that the correct adjustment is made to the formula. If using fresh water-slaked lime increase the lime content of the formula by one-third to one-half extra. Air-slaked lime cannot be used under any circumstances.

In practice the best procedure is to very definitely specify "freshly-burnt" lime when ordering, and then to slake it immediately on its arrival and keep it under water until required, as described in a preceding section of this article.

TESTS FOR BORDEAUX MIXTURE.

Bordeaux Mixture is said to owe its valuable fungicidal properties to a basic copper sulphate from which the ordinary copper sulphate is re-formed in very small quantities from time to time. These quantities are too small to harm the tissues of most plants, but are yet quite sufficient to kill the germinating seed bodies (*spores*) of harmful fungi. If, by some mischance, there should happen to be too little lime in the Bordeaux Mixture to completely turn the bluestone into the insoluble basic sulphate, considerable injury could be caused to any plants sprayed. While there should be very little likelihood of this happening if ordinary care is taken, each lot of Bordeaux Mixture made up should be tested, before using, in one or other of the following ways:—

A. Take a little of the Bordeaux Mixture in a glass vessel, add a few drops of acetic acid, and then add a few drops of a solution of ferrocyanide of potassium in water. (The strength of the ferrocyanide should be 4 ozs. in one pint of water. Both the ferrocyanide and the acetic acid are obtainable from any chemist.) Should any brown discolouration occur, the Bordeaux Mixture does not contain enough lime, and more lime concentrate must be added, until, on further testing, no discolouration is apparent.

B. A rough but useful test which can be made to see if the Bordeaux contains enough lime to neutralise the bluestone is to dip the clean blade of a penknife or a bright piece of iron such as a recently roughened-up shiny nail into the mixture for several minutes. If the mixture does not contain sufficient lime, a reddish-brown deposit of copper will form on the iron and more lime should be added. *Always use a little too much lime rather than a little too little,* as quite a considerable excess of lime may be used without the fungicidal properties of the spray being markedly lowered.

THE USE OF SPREADERS WITH BORDEAUX MIXTURE.

Whenever Bordeaux Mixture is used, the spreading, wetting, and adhesive qualities of the spray will be very greatly improved by the incorporation of a special spray "spreader" or "sticker." In addition, the spray, on drying, will settle down into a very thin, well-distributed and more or less continuous layer, rather than into a number of scattered spots. The fungicide will therefore prove more efficient with a "spreader" than without, as, where the spray dries up in spots, very little, if any, protection is afforded to the tissues in between. Where spreaders are used there is also very much less danger of damaging the leaves or fruit, for the reason that the concentration of the solid materials from the spray is never so intense at any one point as if no spreader is used. Moreover, less spray is used, as there is not such a tendency to hold the spray nozzles for some time in the one place, to try to *force* the material to wet the tissues and stay on.

DIFFERENT MATERIALS USED AS SPREADERS.

The following substances are some of those which have been used from time to time as spreaders, or stickers, in various sprays:—Oils, resins, soaps, glue, milk and molasses; but *calcium caseinate*, a by-product obtained from skim milk, is the only one which has become very popular or widely used.

CALCIUM CASEINATE SPREADER.

Calcium caseinate should be used at the rate of one half to one pound (½—1 lb.) per 50 gallons of spray. In mixing, make the required amount of calcium caseinate into a paste in a billycan, jug, or other suitable receptacle, by putting the caseinate into the dry container and then adding as much water by volume as there is caseinate. Stir, so as to form a thin paste (just in the same way as powdered skim milk is mixed by the experienced housewife for human use) and, when made into a paste, dilute with water and add to the mixture in the spray tank, keeping the agitator going during the process.

Fig. 7.—Spray boom of excellent type, showing the arrangement of nozzles to ensure thorough covering of such crops as potatoes, tomatoes, beans or similar plants grown in rows.

(*After Mason, "Spraying, Dusting and Fumigating of Plants."*)

SPREADERS FOR BORDEAUX MIXTURE OTHER THAN CALCIUM CASEINATE.

If calcium caseinate is not obtainable, one or other of the following substances may be used instead:—

1. A good brand of *commercial powdered skim milk*, used at the rate of ½—1 lb. for every 50 gallons as indicated above for calcium caseinate.

2. *Sweet skim milk*, used at the rate of half a gallon to every 50 gallons of spray.

3. *Flour*, used at the rate of ½—1 lb. to every 50 gallons of spray. Mix with water to a thin paste and then add to the mixture in the spray tank.

4. *Glue*, ½ oz. to every 50 gallons of spray. Dissolve in hot water and then add to the mixture in the spray tank.

5. *Good quality soft soap,* 2—3 lbs. per 50 gallons of spray. Dissolve in water and add to the spray mixture in the spray tank, or barrel, *only just before the spray is to be used.*

6. *"Resin-Fish Oil" Soap,* 2—3 lbs. per 50 gallons of spray. Dissolve in water and add to the spray mixture in the spray tank, or barrel, *only just before the spray is to be used.*

"Resin-Fish Oil" Soap is especially valuable as a sticker and spreader in Bordeaux Mixture for spraying smooth-leaved plants such as cabbages, onions, carnations, etc.

7. For spraying citrus trees or other plants which are not injured by *"prepared white spraying oils,"* ½ to 1 gallon of such oil may be used as a spreader in every 50 gallons of spray.

Another advantage in the case of citrus is that the use of the oil acts as a check on scale insects which otherwise are very apt to increase to serious proportions following Bordeaux sprayings, unless only the lower half or two-thirds of the tree is sprayed. (See Leaflet 354 on "Brown Rot of Citrus and Its Control.")

In using any spray spreader it is advisable not to make the spray liquid in the spray tank, or barrel, up to the full volume until *after* the spreader has been added, so that the strength of the fungicide will always be as much as possible the same whenever it is made up to the same formula. In other words, if making up a 4—4—50 Bordeaux, the *final* volume of spray after the spreader has been added should be just 50 gallons. A mental attitude of exactness should be maintained all through the operations of preparing the Bordeaux Mixture. Carelessness or "slipshod" methods in weighing out or preparing the materials, or in any other part of the operations, cannot be too strongly deplored.

FINAL NOTE.

Finally it should be pointed out that before using the spray apparatus, especially after it has been idle for any length of time, it should be thoroughly washed out to remove any chemicals which may have been left from the previous spraying. This is exceedingly important when the spray being used is a different kind from that previously employed, as, according to Cunningham (2), this mixing of different spray materials in the tank is one of the most frequent causes of spraying injury to plant tissues.

BORDEAUX PASTE.

It is very desirable, after removing large branches from trees, or after cutting out diseased tissues from the trunk or root system, where some such disease as Armillaria or Collar Rot is being dealt with, to paint the wound with some antiseptic material which will prevent invasion of the wound before it heals over.

"Bordeaux Paste" is one of the best materials which may be used for this purpose, or for painting over the wounds made in grafting, after the scion has been inserted and before the grafting wax is applied.

Various formulae are used such as 1½—3—2, 1—2—1½, or 1½—4—1½.

For making up Bordeaux paste according to the last formula (1½—4—1½) take 1½ lbs. of bluestone, 4 lbs. quicklime, and 1½ gallons of water.

Dissolve the 1½ lbs. bluestone in half the water, *i.e.*, ¾ gallon. Slake the 4 lbs. of quicklime with the other ¾ gallon of water. Then pour together and stir thoroughly before using. Apply with a brush as soon after the wound is made as possible.

When not in use the mixture should be kept in a closed container.

LITERATURE CITED.

(1) Butler, E. J.—"Fungi and Disease in Plants." Thacker, Spink & Co., Calcutta, 1918.

(2) Cunningham, G. H.—"Fungous Diseases of Fruit Trees in New Zealand." The Brett Printing Co., Auckland, 1925.

(3) Mason, A. F.—"Spraying, Dusting and Fumigating of Plants." Macmillan Co., New York, 1929.

(4) New South Wales Department of Agriculture—"Spray Leaflet, No. 1, Bordeaux Mixture." Sydney, 1930.

OATS IN THE WHEATBELT.

(Continued.)

R. P. Roberts,
Agricultural Adviser.

The most important varieties of oats under cultivation in Western Australia are "Guyra," "Algerian," "Mulga," "Burt's Early" and "Palestine." As will be seen from Table 3, over ninety per cent. of the area under oats in 1934 was sown to these five varieties.

Table 3.

Variety.	Per cent. of total area sown.	Maturity.
Guyra	37	Midseason
Algerian	27	Late
Mulga	17	Early
Burt's Early	8	Early
Palestine	4	Very early
Other Varieties	7	
	100	

"Guyra" is the standard mid-season variety for the State. It was produced in New South Wales in 1913 as the result of a cross between "Algerian" and "White Ligowo." Like its parent "Algerian," it is drought resistant, but does not tiller so prolifically. On account of its earlier maturity, it can be grown successfully in districts where the season is too short for the former variety. It is valuable on account of its ability to give good yields of plump, high-quality grain which is in demand for feeding purposes.

When it first appeared on the market, this oat was disliked by buyers on account of the dark colour of its husk. However, this prejudice did not survive for long.

The straw is fairly tall, coarse and of medium strength. On account of this coarseness of straw, it is not a favoured hay variety, though often used for this purpose.

"Algerian" was originally introduced into Australia from Northern Africa and has proved the most useful of all the introduced varieties. Compared with English varieties, it was found to be decidedly drought resistant, but its prolific tillering and late maturity render it less suitable for the central wheatbelt than the midseason variety "Guyra," and definitely unsuitable for the eastern wheatbelt; consequently its growth is confined mainly to the wetter western and southern sections and to the dairying districts of the south-west. It is the standard late maturing variety for Western Australia.

The straw is medium tall, slender and of medium strength, while the grain is brown and of good quality. The variety is well suited for either hay or grain production in districts with an average annual rainfall of 18 inches or over.

It recovers well after grazing, but as its early growth is slow, it is necessary to plant early when sowing for this purpose. It can, however, be relied upon to produce a good bulk of green feed during the spring. It suffers from the defect that it is rather unpalatable to stock in the early stages of growth.

"Mulga" is probably the most useful of the varieties in general cultivation in the wheatbelt. It is a selection from "Sunrise" made at Cowra, New South Wales, in 1917.

It matures slightly earlier than "Burt's Early" and is the standard early maturing variety for Western Australia. Because of its early maturity and drought resistance, it is particularly suitable for growing in the drier districts of the wheatbelt.

It has a tall, rather coarse straw of medium strength. The grain is of good quality and creamy white in colour. The variety is suitable for silage, hay, grain or early feed. It makes rapid early growth and produces a good bulk of palatable green feed at the time it is most needed.

Objections often made to this variety are that it grows too coarse a straw to make good hay and is very liable to lodging. This will usually occur when the crop is planted early, say in the middle of April, but the trouble can be largely overcome by planting later in the season. When this practice is followed, the bulk of hay produced is not so great, but the quality is better and the risk of lodging is reduced.

"Burt's Early" is an early maturing variety which originated in the U.S.A. and was introduced into Western Australia about twenty years ago. Until displaced by the more drought-resistant and prolific variety "Mulga," it was the standard early variety for Western Australia.

It has a fairly tall, rather slender straw of medium strength and is popular as a hay variety. It is not widely grown for grain, mainly on account of its unattractive grain and inferior yielding ability, as compared with "Mulga." It is, however, a suitable variety for early green feed.

"Palestine" is a Syrian variety which was introduced into this State from Victoria. It is a very early maturing oat, ripening about a week earlier than "Mulga," and is a suitable grain variety for the drier districts and also in the more favoured rainfall areas when planted late in the season. Compared with "Mulga" or "Burt's Early," it does not produce satisfactory yields of early green feed, silage or hay.

The grain is of satisfactory quality and resembles "Algerian" in appearance. The straw is fairly coarse and, although very short, is rather weak.

As a stock feed, oaten stubble is slightly more valuable than wheaten, and is also more palatable. In addition, as there is usually considerably more grain available on the ground after harvesting an oaten crop, the stubble of such crops usually has a higher sheep-carrying capacity than do the wheaten stubbles.

The value of oats in rotation with wheat is widely recognised. As the crop is not liable to attack by flag smut, root-rot or take-all, it affords a means of combating these diseases. A four-year rotation of wheat, fallow, oats, fallow, gives three successive years in which there is no host plant on which the disease spores can carry over.

In the drier districts, oats, like wheat, will naturally give the best results when planted after a year of bare fallow, but in districts with a heavier and more reliable rainfall, good results are obtained with a rotation of wheat, oats, fallow. Where such a rotation is employed in preference to a wheat, pasture, fallow rotation, the sheep-carrying capacity of the holding is greatly increased. The oats may be utilised for green feed, silage, hay, grain, or it may be left unstripped for summer feed for the sheep.

When grown for grain, oats, under average wheatbelt conditions, do not return the same feed value per acre as does wheat. It does not yield so well in pounds per acre and pound for pound the wheat has greater energy value than the oats, the respective starch equivalent figures being approximately 71 and 59. On the other hand, the oat crop does not always receive the best of treatment, as it is usually regarded as being of secondary importance to the wheat, and is often treated as a scratch crop. Its production costs are, therefore, likely to be somewhat below those of wheat. Further, it is a safer feed for most classes of farm stock than is wheat. Apart from these considerations, however, it is, from the point of view of farm management, a most desirable crop to include in the cropping system in the wheatbelt, and its increased use in rotation with which can be expected to result in increased yields of the latter cereal.

Under Western Australian conditions, the need of green feed is greatest in the late autumn and early winter months. For this purpose "Mulga," followed closely by "Burt's Early," are the best varieties to plant. Unfortunately, the sparse stooling characteristics and tendency to run up into ear early in the season that are associated with the early maturing varieties, are not, generally speaking, allied to good recovery powers following grazing. Consequently, should it be necessary to provide for green feed during the winter and early spring, "Guyra" would be a better variety to plant in the central wheatbelt and "Algerian" in the higher rainfall districts and South-West. The ability to produce grain subsequent to grazing is dependent on the season, variety and stage of growth of the crop when last grazed. If the young ears have appeared at the bottom of the main tillers prior to the removal of the sheep and are bitten off, the yield of grain will be seriously reduced. As this stage of growth is reached much sooner with early maturing than with late maturing varieties, it follows that the former cannot be grazed very far into the winter.

On the other hand, even under normal conditions, the length of the growing season in portions of the wheatbelt does not permit the successful growing of either midseason ("Guyra") or late maturing varieties ("Algerian") for grain. Consequently, should there be a tendency to prolong the life cycle of the plant by feeding off, unsatisfactory results are practically inevitable. For these districts, the dual purpose of early maturing variety "Mulga" is recommended.

The cultural operations associated with the production of oats are very similar to those of wheat. When sown for grain, it is usual to seed at the rate of about a bushel to the acre and apply from 90 to 120 lbs. of superphosphate per acre. When heavier rates of seed are sown, finer straw is produced, but this increases the liability to lodging should the crop be left for grain.

Oats require rather more moisture for germination than does wheat, and they have a shallower rooting system. In a moist seed bed planting at a depth of 1½-2in. is satisfactory, but in a dry seed bed care should be taken to get the grain down to the firm seed bed even if this entails rather deeper planting.

It is a common practice to plant oats before making a start with the wheat crop. This procedure is sound so long as suitable varieties are used, but it is unreasonable to plant an early maturing variety like "Mulga" in the middle of April and expect it either to produce a really good quality hay or to be free from the risk of lodging.

The correct times to plant the different maturing varieties of oats are those periods recommended for the different districts for planting the late, mid-season and early-maturing varieties of wheat.

On account of the risk of loss through shattering, it is advisable to plant two or three varieties of differing maturity as this affords an opportunity of harvesting a portion of the crop before the remainder is ripe.

The most troublesome diseases of oats in Western Australia are loose and covered smuts, the latter being the more commonly noticed and held by farmers to cause the greater losses. Infection with loose smut takes place mainly through smut spores being blown into the open flowers of normal plants at flowering time. These spores become enclosed in the hulls of the grain and infect the subsequent crop in the early seedling stage. Infection with covered smut takes place from spores which either blow about on the wind or come in contact with the grain during harvest time. In any case, spores become caught up in the husks or attach themselves to the outside of the grain. Thus grain from a crop which was apparently free from the disease may give rise to smutted plants the following year. A line of seed may be heavily contaminated with smut spores without this being obvious to the eye. On these accounts, it is advisable to regard all seed as being infected and take the necessary measures for prevention as routine steps.

Seed treatment methods for the control of both loose and covered smut are identical. Thoroughly sprinkling the seed with a solution of formalin (1 pint) and water (35 gallons) at the rate of about one gallon of the mixture to one bushel of the grain will give complete control provided the grain is covered for 6 to 8 hours with bags moistened with the diluted formalin, but the method has the disadvantage that the seed must be planted immediately in a moist seed bed, otherwise germination is detrimentally affected.

Pickling with copper carbonate (2 ozs. per bushel) is more convenient than the formalin treatment and gives a satisfactory degree of control, provided it is thoroughly done, but there is evidence that under certain conditions, germination may be seriously retarded by the copper carbonate, and the subsequent growth somewhat stunted.

This point is being further investigated by the department.

Several mercury dust compounds for use in seed pickling are at present on the market. Of these, both "Granosan" and the original "Ceresan" compound gave complete control of the smut under severe conditions of infection, when tested by the Plant Pathology Branch in co-operation with the Wheat Branch. "Ceresan New" was not so effective as "Ceresan" under experimental conditions, but under ordinary field conditions it is likely to be effective. The dry dust treatments have the advantage over the formalin method that the seed can be treated, with safety, weeks before planting and can be planted in a dry seed bed without injury to germination. They are, however, much more expensive than the formalin method.

As with flag smut of wheat, the best method of control of "loose" and "covered" smuts of oats is through the use of smut resistant varieties. In this direction, "Guyra" and "Mulga" are more resistant than "Burt's Early," "Algerian" or "Palestine."

AN INVESTIGATION OF PLANTS POISONOUS TO STOCK IN WESTERN AUSTRALIA.

H. W. Bennetts, D.V.Sc.

Losses due to the effects of toxic plants have been experienced from the earliest days of settlement in this State. In 1837 "York Road Poison" (*Gastrolobium calycinum*) was responsible for a considerable mortality in stock being driven from York to Perth. Since that time toxic plants have been the source of great economic loss although increasing knowledge of the plants responsible, followed by their eradication, has resulted in a progressive diminution in mortality attributed to this cause.

At the present time there are over 100 species of native and exotic plants which are known to be toxic. The majority of the former, however, belong to two genera, Oxylobium and Gastrolobium, the toxic species of which are, with one exception *G. grandiflorum*, confined to Western Australia.

Our knowledge of native toxic plants is still very incomplete. Herbert (2) in 1921 published a Bulletin summarising the information then available. A second edition of this Bulletin, revised by Carne, Gardner, and Bennetts, was issued in 1926. The results of some further experimental work were recorded by the writer, Bennetts (1). Practically all the data recorded in these publications is based on the observations of stock owners, and experiments carried out on laboratory animals. It has long been recognised that such information is far from satisfactory, but until recently opportunity for more accurate experimental work was lacking.

In 1934 at the instigation of the Government Botanist a co-operative investigation of known and suspected toxic plants was commenced, he carrying out the taxonomic and the writer the experimental work. The scope of the latter was limited to the determination of the toxicity for sheep, and symptoms and pathological changes induced.

It is proposed to issue, at a later date, a Departmental Bulletin giving a comprehensive account of the toxic plants of Western Australia. This will of necessity be of a popular nature. The purpose of this article, therefore, is to record the results of the experimental work carried out by the writer, in connection with the project, from August to November, 1934.

1 Experimental Methods.

Specimens of plants were collected from type localities by the Government Botanist and forwarded immediately to Beverley for testing. In most instances specimens consisted of flowers (or young pods). The majority of plants tested belonged to the genera Gastrolobium and Oxylobium, many species of which can be determined only when in the flowering stage; further, it is known that they are most toxic when flowering or fruiting—the flowers and fruits being the most highly toxic parts of the plant. The determinations of toxicity for sheep were carried out at the Avondale State Farm, Beverley, where the necessary paddock, yard and pen accommodation, as well as laboratory facilities, are available.

The experimental sheep consisted of a flock of 100 cull for age ewes. It was found necessary to use again sheep which had survived previous experiments but invariably considerable periods elapsed between tests and as far as possible plants of related genera were not administered to the same sheep on a future occasion. Only three sheep survived the series of experiments.

In most instances plants were administered in the feed. Subjects were kept on a low ration of chaff for several days prior to test. They were fed in pairs in pens or yards. The usual test ration consisted of plant material 4-8 ounces (generally flowers rubbed up with rough leather gloves), chaff 8 ounces and bran 8 ounces. With few exceptions such feeds were readily eaten, and there was no evidence of selective tendencies.

Drenching with plant extracts was resorted to when sheep could not be induced to eat feeds containing the plant, e.g., *Isotoma petraea, Senecio lautus* With *Gastrolobium spp.* and *Oxylobium spp.* (spp = species, plural; sp. = species, singular) it was found that drenching and feeding gave identical results. Drenching experiments were more informative with regard to the effects of different amounts. In general at least two sheep were fed or drenched with material from each plant submitted; frequently both methods of administration were tried on different subjects. Where special information was desired, from 10 subjects (with *G. callistachys*) to 13 subjects (with *O. graniticum*) were treated with a fatal result. Some extracts of *Gastrolobium spp.* and *Oxylobium spp.* were administered subcutaneously or intravenously for reasons given later.

Feeding or drenching tests were repeated once or twice daily until a positive result was obtained or the supply of plant material was exhausted. The approximate amounts ingested were determined.

Preparation of Extracts.—Extracts were prepared from finely minced plant material. This was soaked with frequent stirring, for from 1½ to 24 hours in water in the proportion of about 40 gm. to 100 c.c. of water. The shorter period was used throughout for *Gastrolobium spp.* and *Oxylobium spp.* on account of previous evidence of instability of toxic principles—it having been shown too that these are highly soluble in water *(Bennetts (*loc.c.*)). After the stated interval fluid was expressed in a tincture press and this extract used for drenching. Any extract remaining was stored for further use, 0.5 per cent. chloroform being added as a preservative. Contrary to expectations such extracts from most plants belonging to the aforementioned two genera showed no appreciable loss in toxicity when tested 2-3 months later.

In most instances a number of species of plants were being tested simultaneously. As poisonous species belonging to the genera Gastrolobium and Oxylobium are so highly and rapidly toxic it was possible to test a great number in a comparatively short time. For the same reason it was necessary to make, at least, hourly clinical observations throughout the day; frequently also at night. The action of the plants on animals at rest was noted and the effects of exercise and other external stimuli (noise, throwing of gravel etc.) was determined. In some instances haematological determinations (blood examinations) were made.

2. Plants Tested.

During the period from 28-8-34 to 6-12-34 sixty plant specimens, comprising 51 individual species†, were tested for toxicity. Duplicate samples of the same species collected from different localities on different occasions are included. In some cases both leaves and flowers were submitted for individual trial.

* The proportion of the toxic material removed in this way was generally considerable, the residue being relatively non-toxic. This, however, was not always so. An extract from 140 gm. of *G. calycinum* was administered to a sheep, with fatal consequences. The following day the residue was again extracted and this extract caused the death of a further sheep to which it was administered.

† Including four varieties of *G. spinosum*.

The following comprises a complete list of species tested. Plants proved toxic are indicated by *. Numerals indicate serial numbers of plant specimens:—

MONOCOTYLEDONEAE.
LILIACEAE.

‡40 Stypandra imbricata, R. Br. = "Blind Grass."

DICOTYLEDONEAE.
PHYTOLACCACEAE.

30 Gyrostemon ramulosus, Desf. ♂ & ♀

CAESALPINIACEAE.

18 Cassia pleurocarpa, F.v.M.

PAPILIONACEAE.

50 Oxylobium coriaceum (Sm.) Gardner.
48 Oxylobium lanceolatum (Vent.) Druce.
51 „ reticulatum, Meissn.
*13 „ graniticum, S. Moore = "Granite Poison."
*1, 17 „ parviflorum, Benth. = "Box Poison."
*16 „ revolutum, Gardner = "Mallee Poison."
*— „ tetragonophyllum, E. Pritzel = "Brother Brother Poison."
20 Mirbelia taxifolia, Gardner (MS.).
*27 Isotropis cuneifolia, (Sm.) Domin. var. parviflora, Benth. = "Lamb Poison."
25 Gompholobium marginatum, R. Br.
4 Gastrolobium Brownii, Meissn.
5 „ reticulatum, (Meissn.) Benth.
44 „ sp. not determined yet.
7 „ Stowardii, S. Moore.
46 „ tricuspidatum, Meissn.
10 „ obovatum, Benth. = "Boat Leaved Poison."
21 „ seorsifolium, F.v.M. = "Yilgarn Poison."
26 „ ilicifolium, Meissn.
23a „ villosum, Benth. } = "Crinkly Leaved Poison."
23 „ polystachyum, Meissn. }
*6, 43 „ ovalifolium, Henfr. = "Runner Poison."
9a, 11, 31 & *33 „ spinosum, Benth. = "Prickly Poison."
*37 „ ? rotundifolium, Meissn. (name to be checked) = "Gilbernine Poison."
*45 „ densifolium, Gardner = "Mallet Poison."
*22 „ floribundum, S. Moore = "Wodgil Poison."
*32 „ Laytonii, J. White = "Kite Leaved Poison."
*35 „ microcarpum, Meissn. = "Cluster Poison."
*2 „ oxylobioides, Benth. = "Sand Plain Poison."
*39, 3, 24 „ calycinum, Benth = "York Road Poison."
*12, 34 „ sagittulatum, S. Moore.
*41 „ Callistachys, Meissn. = "Rock Poison."
*9 „ crassifolium, Benth.
8 „ compactum, Gardner (MS.)
* „ parvifolium, Benth. = "Berry Poison."
*38 „ hamulosum, Meissn. = "Hook Point Poison."
*52 „ velutinum, Lindl. = "White Gum Poison."
*49, 53 „ bilobum, R. Br. = "Heart Leaved Poison."
19 Swainsona canescens, (Benth.) F.v.M.

‡ *Stypandra imbricata.*

Leaves of flowering plants were collected locally and fed to sheep at Avondale during October, 1934. The results of this experiment were very indefinite.

A further experiment carried out at Perth in July, 1936, with material forwarded from Kununoppin gave positive results. The administration of young green leaves to experimental sheep resulted in the early appearance of a shifting lameness and permanent blindness due to degeneration of the optic nerve. The details of both experiments will be reported later.

SAPINDACEAE.

42 Dodonaea bursarifolia, Behr. & F.v.M. = "Native Hop."

RHAMNACEAE.

36 Cryptandra leucophracta, Schlecht.

SOLANACEAE.

Solanum Oldfieldii, F.v.M.
47 Anthocercis viscosa, R. Br.
*28, 29 Duboisia Hopwoodii, F.v.M. = "Pituri."

LOBELIACEAE.

14 Isotoma petraea, F.v.M.

COMPOSITAE.

?*15 Senecio lautus, Soland.

3. The Toxicity of Gastrolobium and Oxylobium.

As indicated, 4 of the 7 species of Oxylobium, and 16 of the 30 species of Gastrolobium tested, proved toxic for sheep. All these plants are highly toxic, the ingestion of amounts equivalent to from 14-450 gm. (½-15 ozs.) of plant material, chiefly flowers and pods, being followed by death in from 3 hours to 3 days. In general the administration of under 150 gm. (5 ozs.) was followed by death within several hours. The effects produced by all toxic species of both genera are essentially the same. It will suffice, therefore, to give a general account of symptoms and post mortem appearances.

(i). *Symptoms.*

In the bulletins referred to, two types of syndrome (collection of symptoms) were described—one characterised by madness, trembling and convulsions, said to be produced by certain species (*e.g., G. calycinum, O. parviflorum*), and one characterised by drowsiness and paralysis, following the ingestion of *G. bilobum* and *G. ovalifolium*, etc. It was early realised that this conception was incorrect. It appears quite evident that all toxic species with the possible exception of *G. bilobum*, which requires further investigation, may produce either type of syndrome.

General.—Whatever type of syndrome is produced cardiac and respiratory phenomena are invariably marked. A weak and accelerated heart beat appears to be the first sign of poisoning—it is invariably present when there are other manifestations. The heart rate usually exceeds 150 and is frequently up to 240 per minute, the beat becoming very weak and generally within a short time almost imperceptible. Cardiac phenomena are more marked in rapidly fatal cases than in subjects which last longer than 8 or 9 hours. Acceleration of respiration (breathing) is also an early sign—frequently the first recognised. Some acceleration is invariably present—the increase may be progressive or there may be a sudden jump to about 70 per minute in an animal at rest. Generally following the appearance of signs of nervous stimulation the respiration progressively increases up to 200 per minute or more, becoming noisy (as a result of oedema (dropsy), congestion and haemorrhage of the lungs) and panting. Flecks of blood-stained froth appear in the mouth following haemoptysis (bleeding from lungs), and frequently a few ounces of blood exude from mouth and nostrils. It is obvious that driving will increase the respiratory distress, and in some cases, where animals have ingested large quantities of toxic material, cardiac and respiratory distress become very acute and death may occur within a few minutes of symptoms being first noticed, other signs of poisoning being absent. In some cases a double expiratory effort is noticed. If such animals are driven, respiratory distress becomes acute, and if death is delayed for some days lobar pneumonia may supervene. Frequent

micturition (passing of urine) appears to be a general sign. Temperature was not elevated in subjects examined, and where haemoglobin estimations and red cell counts were made normal figures were obtained.

Depending on the neuro-muscular (nerve and muscle) manifestations three types of syndrome are recognised:

"A" Type of Syndrome.—This is characterised by pronounced hyper-excitability and mania. The initial signs are cardiac and respiratory phenomena, frequent decubitus (lying down) and some evidence of nervous stimulation, such as twitching of ears and eyelids, lifting of forelegs up and down. Evidence of nervous excitability is soon manifest, pupils are dilated and eyes "starey," the animals are hyper-sensitive to stimuli of sight, touch or sound and appear unusually alert. The animal starts at any unusual sight or sound such as the appearance of a dog or the banging of a door, gives an exaggerated response if pebbles are thrown and struggles violently if caught. Suddenly it gallops around in a circle or straight across the yard into a fence. This mania may develop independently of any external stimulus, but is precipitated by such. If caught the animal struggles to escape and one can feel the periodic general violent clonic muscular spasms (convulsions) which are apparent when the animal is circling or standing. These periods of galloping last only for one or two minutes but recur at frequent intervals—in the intervening periods the subject stands uneasily, showing signs of extreme hyper-sensitiveness. External stimuli precipitate further general clonic spasms and galloping. Meanwhile respiration has become progressively accelerated and noisy—haemoptysis is frequently present. Finally the animal falls over while galloping, or following generol violent clonic spasms and lies on its side making violent galloping movement, alternating with either opisthotonos or emprosthotonus (body bent rigidly backwards or forwards). There is sometimes a chorea (twitching) of facial muscles. The general appearance is not unlike a case of enterotoxaemia. Occasionally, otherwise continuous violent galloping movements are interrupted by a regular periodic rigidity of the whole body associated with a momentary inhibition of respiration, apparently due to a spasm of the diaphragm. Such types have been observed to linger in this condition for upwards of an hour, the respiration rate being over 200 per minute. Death generally occurs within two hours of the first signs being detected, frequently within a few minutes. In some cases death appears to be practically instantaneous; an apparently normal sheep as the result of a noise, such as a door banging, suddenly jumps into the air and falls down on its side in emprosthotonos or opisthotonos. Some cases, particularly if not disturbed, may pass into a "B" type syndrome and ultimately recover. Exceptionally a subject may remain hyper-sensitive for some days and recover.*

Experimental evidence supports field observations to the effect that the disturbing (*e.g.*, with dogs) of sheep which have been "on poison" precipitates acute symptoms and increases mortality.

"Intermediate" Type of Syndrome.—This is characterised by absence of mania. Hyper-sensitiveness is moderate or absent. Clonic muscular spasms are marked. The initial signs are similar to those of the previous type, but frequently the first sign noticed is trembling of facial muscles or clonic spasms of the hind limbs. Occasionally grinding of the teeth is a premonitory sign. If undisturbed the animal remains for long periods in sternal decubitus (normal lying down position). When standing general clonic spasms occur and when walking there are periodic spasms particularly of hind limbs. The subject may lean against the side of

* One sheep following ingestion of *G. calycinum* appeared to be on the verge of mania but did not "gallop." This sheep remained extremely hyper-sensitive to stimuli for several days, after which it gradually recovered, although it became very poor.

the pen for support, spasms being almost continuous. Soon the legs are unable to carry the animal and it lies down. Clonic spasms are usually absent during decubitus, but their appearance may be stimulated by touch or noise. Death usually occurs within 2 or 3 hours of symptoms being first noted and may be violent as in the previous type, or the animal may die quietly in sternal decubitus. Sometimes the "B" type of syndrome supervenes, with delayed death in one or two days, or recovery.

"B" Type of Syndrome.—This is characterised by depression and muscular weakness. Typically the animal is definitely dull and remains so—clonic spasms are absent.

In some cases a preliminary period of stimulation is noted (A and Intermediate Type) but generally this is not observed, the initial signs being decubitis and dullness with weak, rapid heart beat and some increase in respiratory rate, about 40 per minute. When standing the sheep adopts a dejected humped attitude with head and ears depressed, the nose sometimes almost touching the ground. In occasional cases the respiration, at rest, is suddenly accelerated to 100-240 per minute. When let out of the pen the animal may brighten up and walk or run off with the head held high. The feet are lifted high and "plopped down" and the hind legs are straddled. If driven with other sheep the subject soon lags and acts as though it were alone. After proceeding for 50 yards or so the sheep stands in the characteristic dejected attitude and allows the observer to approach. It appears sulky and will not move even with prodding, and generally lies down. The animal appears paretic (paralysed) and has little traction power in the hind legs. If these are forcibly extended fully behind the animal it continues to lie in this position and will, in fact, lie in almost any position in which placed. If carried the legs drag on the ground. The heart is weak and accelerated. The rate of respiration is increased—frequently a double expiratory effort is observed. A few minutes rest is followed by partial recovery—the sheep will get up on approach and will again proceed for a short distance as before. If disturbed and driven at frequent intervals the condition is accentuated and respiratory distress becomes manifest—the rate being greately accelerated and the sheep pants with the tongue hanging out; pneumonia may supervene. If left undisturbed the animal generally stands dejectedly or remains in sternal decubitus—it may even act in a normal manner.

Death may occur within several hours but is frequently delayed for from one to four days. This usually takes place quietly but may be preceded by galloping movements, emprosthotonos or opisthotonos as in the other types. Many cases, if not disturbed, frequently show a gradual recovery over several days.

Although the typical types of syndrome, as described, are well defined they merge into one another, and the same animal may occasionally show all types. The general progression is from stimulation to depression with delayed death or recovery. In a few instances, however, peculiar alternations have been observed: *e.g.,* one sheep drenched with a large amount of one of the more weakly toxic species (*G. hamulosum*) first showed a typical B syndrome with marked dulness. It suddenly exhibited violent nervous stimulation and mania (typical A type). Several further alternations between depression and stimulation were followed by death, immediately preceded by mania, six hours after drenching.

(ii) *Post Mortem Appearances.*

The outstanding features are marked general congestion and delayed clotting of blood—this not being complete until several hours after death. The carcase appears full of blood and if examined soon after death blood pours out of any viscera which are cut and the marked congestion of liver and dilation of heart no longer will be apparent. The lung lesions are characteristic.

Subcutaneous tissue.—Injected.

Serous membranes—Injected.

Liver.—Generally deeply congested, frequently appearing a livid purple, but occasionally only mottled with reddish areas of mild congestion. On incision dark blood pours out of the organs, which then appears normal except for patchy subcapsular congestion. In subjects postmortemed the liver was generally fatty.

Gall Bladder.—Frequently appears dark and injected externally. The contents are generally normal in quantity, colour from normal to turbid dark brown. The mucous membrane is generally desquamated, may be injected and petechiated (small haemorrhages).

Kidneys.—Generally deeply congested throughout.

Spleen (melt).—May be normal but is frequently somewhat swollen and soft in consistency. On section may be mottled with large areas of soft dark tissue or diffusely tarry.

Bladder.—Almost invariably empty, normal. Two sheep inoculated subcutaneously and one inoculated intravenously with extract showed haematuria (blood in the urine), the presence of red cells being determined microscopically.

Rumen (paunch).—Normal—the character and amount of contents varied considerably according to preliminary treatment of subjects—appreciable quantities of undigested toxic plant material were frequently recognisable.

Reticulum and Omasum.—Normal.

Abomasum (fourth stomach).—Generally normal but occasionally may show injection or longitudinal pink striping corresponding with a linear petechiation of summits of the folds of m.m. (mucous membrane = lining). This may also be diffusely injected and may be petechiated, petechiae being in small groups, diffuse, or in linear series as indicated. Occasionally the m.m. is greyish and roughened, and near the pylorous may be thickened and sloughing.

Small Intestine.—Some lesions (changes in structure) are invariably present but the degree varies—less pronounced in the B than in the A and Intermediate syndromes. Externally the bowel is injected and frequently large areas, notably near the beginning and end, may be diffusely rose red in colour. The m.m. of the duodenum generally shows irregular aggregations of large bright red petechiae, but may be diffusely petechiated and injected, appearing haemorrhagic. It may be thickened and sloughing, patches of desquamated epithelium being found in the contents which are thick and mucous, or deeply blood-stained. Generally after the first five or six feet the m.m. is injected and finely petechiated, the haemorrhages being grouped in irregular horizontal bands, giving a striped appearance. This gradually shades off into normal bowel towards the last several feet of the ileum. Occasionally there are patchy areas of diffusely haemorrhagic m.m., particularly in the ileum. In more chronic cases of poisoning the bowel lesions may be confined to a mild degree of fine petechiation and injection of the m.m., generally more evident in the anterior third.

The contents of the first 20-30 feet of bowel may be deeply bloodstained where lesions are severe or may be normal throughout.

Large Intestine.—The m.m. of the caecum and to a less extent of the colon shows a variable degree of injection—generally slight. The rectum occasionally shows longitudinal striping. One sheep which died four days after drenching with an extract of *G. oxylobioides* showed an unusual lesion in the caecum. The m.m. was diffusely petechiated, and there were frequent irregular raised haemorrhagic areas up to about 5 mm. in diameter. The contents were fluid and bloodstained.

Lungs.—Almost invariably there is a bilaterally symmetrical lesion affecting the base of the right and left lobes. Externally an area varying from only an inch or so in extent to one embracing the basal half is mottled with large blotchy

dark bluish haemorrhages. The lesion is always more extensive dorsally than ventrally and, if small, the ventral surface may show only occasional discrete haemorrhages 4-5 mm. in diameter. On section the lung is very deeply congested and mottled with large dark haemorrhages, the whole section appearing much darker than normal. Blood pours out of the incised area. Proceeding anteriorly the lesion becomes less marked, the congestion being less definite and haemorrhages smaller until the lung appears normal except for occasional dark haemorrhages a few mm. in diameter. The apical lobes are generally practically normal, but if the lesion is extensive may show small haemorrhages. The bronchi and trachea are more or less filled with frothy bloodstained fluid, and, if post-mortem is delayed, with blood clots. The mucous membrane is congested. Rarely lungs are normal or only slightly congested.

The nasal mucous membrane is dark and deeply congested and the nasal cavity may contain blood.

Brain.—The vessels of the pia mater are very deeply injected.

Lesions following subcutaneous inoculation are similar to those following ingestion, but are usually severe, notably the intestinal lesions. It would appear that the latter are not necessarily due to a local irritant effect.

Typical lung lesions associated with the bowel changes and a marked general congestion are regarded as being pathognomonic (characteristic) of poisoning with *Gastrolobium spp.* and *Oxylobium spp.*

(iii) *Microscopic Appearances.*

The picture is one of marked general congestion associated with toxic changes.

Liver.—There is a marked congestion of capillaries and veins, particularly those in portal canals, which are greatly dilated. In most cases the blood has escaped on excision of the tissue, but where post-mortem examination has been delayed the vessels are packed with r.b.c. The liver cells show cloudy swelling and fatty changes.

Gall Bladder.—Marked congestion and epithelial cells may be desquamated. Frequently there is extensive necrosis.

Kidney.—There is a varying degree of congestion—generally very greatly marked throughout. The cells lining tubules, particularly the convoluted, show toxic changes, being cloudy or fatty. Occasionally nuceli are pycnotic and cells may be definitely necrotic. Rarely practically the whole organ apart from the glomeruli may be so affected. Changes are more marked following subcutaneous inoculation with extracts. The congestion is then enormous, glomeruli are swollen, and there is exudation into Bowman's Capsules. There may be definite haemorrhage into tubules, the collecting tubules containing blood casts. A degree of haemosiderosis may be present—in one case following inoculation a great proportion of cells lining the convuluted tubules were packed with haemosiderin.

Spleen.—A varying degree of congestion—in some cases there are numerous large blood lakes. Haemosiderin may be present in large amounts.

Gastro-intestinal Tract.—A varying degree of congestion of the mucosa and submucosa is present, vessels and capillaries frequently being greatly dilated. The villi may be greatly congested with haemorrhagic tips. The mucosa may be necrotic throughout with much of the membrane desquamated.

Lungs.—Sections of typical lesions show varying degrees of congestion, haemorrhage and oedema. Generally the haemorrhage is very severe, practically all the alveoli over large areas of the section being packed with r.b.c. which are also numerous in bronchioles and many bronchi. In one case, referred to, there was lobar pneumonia. Haemosiderosis is occasionally present.

Heart.—May show capillary congestion.

Brain.—The vessels of the pia mater are deeply injected with blood and there is generally some capillary congestion throughout.

Spinal Cord.—May show capillary congestion and occasionally small haemorrhages, particularly in the grey matter.

(iv) *Evidence of Identity of Action of Plants Belonging to the Genera Gastrolobium and Oxylobium.*

As already indicated the symptoms and pathological changes are practically identical throughout. In many instances the same species gave a different type of syndrome in the same feeding or drenching experiment. Different specimens of the same plant may tend to produce different types of syndrome. In general, however, it was noted that under the usual experimental conditions a given species had a tendency to produce one particular type although capable of producing all types.

The evidence indicated that the type of syndrome produced depended on the amount of plant ingested and the degree of toxicity. Experiments therefore were carried out to determine the effect of dosage. Sheep were drenched with graded amounts of extract corresponding to from 28 to 430 gm. of plant material from representative species:—

G. calycinum, *G. Callistachys*, *G. Laytonii* — Plants tending to produce the A type (highly toxic).

G. floribundum, *O. graniticum* — Plants tending to produce the Intermediate type (highly toxic).

G. hamulosum, *G. ovalifolium* — Plants tending to produce the B type (not so highly toxic).

O. tetragonophyllum=Highly toxic but producing B type with small doses.

The results of this series of experiments tended to confirm the previous indications that full doses of the more highly toxic plants or very large doses of the less toxic plants gave rise to an "A" or intermediate type of syndrome and that amounts of all species, approaching a minimum toxic dose, tend to produce a "B" type of syndrome. The results obtained, however, were not altogether clear cut, and it was thought that the parenteral route of administration (other than by the mouth) would eliminate the unknown factor of the physiological state of the digestive tract. Sheep, therefore, were inoculated subcutaneously (below the skin) with extracts in doses corresponding to from 12-60 gm. of the original plant material (*G. Callistachys* and *O. graniticum*). Results tended to be erratic and uncertain—more reliable results following the administration of corresponding amounts by the mouth.

It is concluded that the toxic principles of Gastrolobium spp. and Oxylobium spp. if not identical are at least similar, the effect produced varying with the amounts of plant ingested and the degree of toxicity of the species.

The mode of action is complicated. Dilation of pupils and rapid heart rate suggest sympathetic stimulation—there is also evidence of general nervous stimulation followed by depression. The weak heart and resulting venous congestion are suggestive of a direct toxic action on the heart muscle.

The haemorrhages into the alveoli of the lung and the small intestine may be due to a toxic action on the walls of capillaries. The haemodiderosis, sometimes observed, would appear to indicate some haemolysis although this has not been demonstrated conclusively. One Van Den Burgh determination gave a negative result. The increase in respiratory rate is independent of lung congestion and haemorrhage, and is probably due to an increase in CO_2 content in the blood resulting from the sluggish circulation.

4. The Toxicity of Isotropis cuneifolio (Sm.) Domin.

This and related species are commonly known, locally, as "Lamb Poisons." Numerous tests with this and other *spp.* had given negative results with laboratory animals despite field evidence of toxicity. A positive result, however, was obtained with material from the Hill River district, *var. parviflora, Benth.*

(i). *Feeding Test.*—The whole flowering plant was fed. It was, at first, readily eaten. Two sheep consumed 1 pound in a few hours but only a further $1^3/_4$ lbs. were eaten in the succeeding 2 days.

(ii). *Symptoms.*—The first sign was the passing of pultaceous faeces some 40 hours after the first feed had been eaten. The symptoms noted were persistent diarrhoea, dullness, tucked up appearance and roach back, frequent decubitus, and anorexia (loss of appetite). On the third day blood and mucous were present in the faeces. The sheep became progressively weaker, particularly in the legs. When standing none of the joints of the hind limbs were fully extended. Sheep No. 1 died seven days after the commencement of the test and Sheep No. 2 three days later.

(iii). *Post Mortem Appearances.*—In both cases the liver was somewhat congested and the cortex of the kidney very pale (in one case petechiated); there was petechiation of the *m.m.* of the abomasum and small intestines—the latter being also injected. Sheep No. 2 showed many other lesions: extensive gelatinous subcutaneous oedema, the abdomen contained about one pint of gelatinous fluid, similar material being noted on the serous membranes and around viscera; the thoracic cavity contained about a pint and a half of straw coloured fluid which set on exposure to air. The gastro-intestinal changes were marked, the small intestine being catarrhal and the *m.m.* of the caecum petechiated. The mucous membrane of the colon was striped with horizontal areas of haemorrhage about 2-4 cm. long by 1-2 mm. wide. Towards the posterior two-thirds of the colon similar areas showed various stages of ulceration. The contents of the colon were, in places, blood tinged. The lungs showed patches of early pneumonia.

Microscopically the most marked changes were in the kidneys, which in both cases were affected with acute parenchymatous nephritis, hyaline casts being frequent. The lungs of Sheep No. 2 were affected with croupous pneumonia.

5. The Toxicity of Cryptandra leucophracta.

Two sheep ate 14 ounces of flowers and leaves in 48 hours and a further 2 ounces during the succeeding 48 hours. Unfortunately further plant material was not available and the experiment could not be brought to a satisfactory conclusion.

(i). *Symptoms.*—In both animals signs of poisoning were apparent within twenty hours but were most marked in sheep No. 178, and remained so throughout the period of observation. This animal adopted a curious crouched attitude—the head being held high and the posterior portion of the body being very low by reason of excessive flexion of the hocks. At rest the hocks remained in contact or were crossed, the animal sitting on them. There was a practically continuous shivering of the trunk and neck, the skin being hyper-aesthetic (excessively sensitive). A periodic mild spasm of the hind limbs gave rise to a recurrent upward tilt of the hind quarters. For some days this occurred every 4 or 5 seconds. The symptoms were more noticeable at rest; when driven the gait appeared normal.

The absence of spasms and shivering was first noted fourteen days after the commencement of the test but the crouched attitude was still very evident when the sheep was killed for *post mortem* some five weeks later.

(ii). *Post Mortem Appearances.*—Sheep No. 178 when killed for the collection of nervous tissue showed no lesions. Marchi preparation of the spinal cord showed occasional scattered degenerated nerve fibres. There were a few small haemorrhages in the grey matter of the lumbar cord.

6. The Toxicity of Duboisia Hopwoodii.

Two samples were submitted, one consisting almost entirely of flowers, and one of leaves

Flowers.—Two sheep ate 15 ounces of flowers in 2 days and one sheep was drenched with extract from 3 ounces. The result was negative.

Leaves.—As leaves were not eaten readily drenching was resorted to. One sheep drenched with an extract from 10 ounces died within 10 minutes; extracts equivalent to 3 ounces produced death within two hours, and to 1 ounce symptoms followed by recovery.

(i). *Symptoms.*—Sudden death with large amounts. With smaller amounts dullness, trembling, muscular weakness—particularly of fore-legs and neck, the head being carried low and the ears drooped. The limbs are excessively flexed. When driven there is some inco-ordination of gait and the animal is only able to progress short distances. One sheep when driven showed a great weakness in the fore-legs which collapsed after every few yards, the animal falling down head first. There may be evidence of abdominal pain, viz., groaning and turning head into the flank. Decubitus is frequent. Death occurs rapidly and is either quiet or preceded by occasional galloping movements in lateral decubitus. There is a regurgitation of ruminal contents before death.

(ii). *Post Mortem Appearances.*—The liver was fatty in cases examined. The kidneys are congested throughout; the spleen may be soft and dark; the small intestines are deeply injected externally and may be, in places, diffusely rose red in colour. The *m.m.* of the first several feet may be diffusely petechiated or may be necrotic (dead), flakes of desquamated tissue being found in the thick mucous contents. The necrotic *m.m.* may have a lace-like appearance. After the first 10 feet or so the *m.m.* shows a more or less marked degree of petechiation with an aggregation of petechiae into roughly horizontal bands—it may also be catarrhal. The epicardium is petechiated.

Microscopically the kidneys are congested and the epithelium shows toxic changes—the mucosa of the small intestine shows congestion and haemorrhages. Both mucosa and submucosa may be necrotic.

7. The Toxicity of Senecio lautus.

Unfortunately only flowers were submitted for test. Two sheep were drenched on four consecutive days with aqueous extracts, plant material being soaked for 24 hours before pressing. Each sheep received a total amount equivalent to 18 ozs. of flowers. The dried residue of extracts was eaten in the feed on the two succeeding days.

(i). *Symptoms.*—None observed.

(ii). *Post Mortem Appearances.*—One sheep killed four weeks later showed evidence of definite early liver cirrhosis (chronic inflammation). The second sheep killed six weeks after test showed no evidence of liver abnormality.

There is some evidence, therefore, that the continued ingestion of this plant would be followed by harmful results. It is intended to carry out a further test with the leaves.

BIBLIOGRAPHY.

1. Bennetts, H. W.: Contributions to our knowledge of Western Australian Poison Plants. Proc. Roy. Soc. W.A., 14: 7-21, 1927.
2. Herbert, D. A.: The Poison Plants of Western Australia. W.A. Dept. Agric. Bull. 96, 1921. Revised Edition 1926.

STALLION REGISTER, 1935-36.

Registrations prior to 21st November, 1935.

*Note.—Age in years: A. aged; D. draught; Ar. arab; T. thoroughbred; Tr. trotter; P. pony.

Name.	*Age and Class.	Owner and Address.
Admiral Fyvie	A.D.	C. E. Potts, Pingelly
Ahitana Bold	A.D.	R. Snow, Wickepin
Aldersyde Hero	8 D.	J. B. Stacey, Southern Cross
Aldersyde Manxman	3 D.	L. O. Smith, Bullsbrook
Alfred Donald	A. Tr.	F. C. Thomas, Osborne Park
Ace Black	A. Tr.	F. H. Clifton, Ludlow
Allandale Duplicate	5 D.	G. Hatwell, Dowerin
Altar Star Prince	7 D.	F. W. Evans, East Kondut
Anama Cashier	3 D.	S. Hunter, Yandanooka
Anchor	A. Ar.	A. A. Toll, Highbury
Antique	A. Tr.	T. E. Diver, Yorkrakine
Armada	A.D.	M. S. Fisher, Corrigin
Auchen Bloom	4 D.	G. W. C. Ward, Harrismith
Auchen Pride	5 D.	J. Fitton, Moulyinning
Avinak Major	3 D.	Thorn & Champness, Kojonup
Avon Lad	8 D.	J. H. Bullock, Kulin
Balmoral Yet	3 D.	H. F. Carruthers, Lake Grace.
Barney	8 D.	A. Low & Son, Kellerberrin.
Baron Alan	4 D.	Boolardy Pastoral Co., Walebing
Baron Banchory	6 D.	P. Strange, Yarding
Baron Brayton	A.D.	J. Carr, Beverley
Baron Breastknott	A.D.	F. W. Gibbs, Dinninup
Baron Buchlyvie Stamp ...	6 D.	J. Wood, Mullewa
Baron Caledon	A.D.	W. Johnston, Billaricay
Baron Clyde	6 D.	W. Hewett, Kunjin
Baron Dale	A.D.	A. W. Wilkins, Dukin
Baron's Fancy	6 D.	F. S. Morgan, Quindanning
Baron Glen	8 D.	G. A. Howlett, Karlgarin
Baron Hillgrove	6 D.	C. Smith & Sons, Yarding
Baron Hillside	6 D.	R. Gault, Greenhills
Baron Jock	A.D.	G. Walton, Bilbarin
Baron Lee	A.D.	M. A. Wickham, Yarloop
Baron Lothian	8 D.	J. C. Bushell, Watheroo
Baron's Pride	6 D.	W. J. Maynard, Red Lake
Baron Rosemont	A.D.	A. Thorn, York
Baron's Sovereign	A.D.	S. C. Gill, Kulyalling
Baron's Stamp	A.D.	D. Our, Newdegate
Baron Victor	5 D.	E. G. Marsh, Kojonup
Baron Victor	4 D.	M. Lucas, Beverley
Baron Walder	6 D.	J. Kay, Baandee
Baron Ward	A.D.	J. N. Ford, Narembeen
Beau Valley	3 D.	G. J. Bostock, Pingelly
Beechside Middy	8 D.	L. B. Bolton, Namban
Benowrie Bright Dell	5 D.	R. Carroll & Son, York
Benowrie Crest	4 D.	W. K. Miller, Charlie's Creek, *via* Donnybrook
Bill Adey	5 D.	H. R. Renk, Damboring
Bingley Lad	D.	A. J. Young, Kondinin
Black Baron	7 D.	H. V. Boundy, Babakin
Black Flashdale	4 D.	S. D. Broadbent, Wongan Hills
Black Nugget	3 D.	H. Barnes, Harvey
Black Oak	A.D.	F. E. Brockman, Dudinalup, *via* Balingup
Black Prince	5 D.	Franklin & Sons, Wyola
Bloomfield Sensation	6 D.	L. R. Blight, Mukinbudin

STALLION REGISTER, 1935-36—*continued.*

Name.	*Age and Class.	Owner and Address.
Blue Ribbon Hero	6 D.	L. S. Bell, Katanning
Bob	6 D.	Trotter Bros., Kulin
Bold Enterprise	3 D.	W. R. Falconer, Trayning
Bold Everest	6 D.	A. H. Young, Aldersyde
Bold Honour	3 D.	J. Carstairs, Perenjori
Bold Major	6 D.	C. W. Heal, Quairading
Bonnie Vale	A.D.	R. Bungey, Borden
Bonny	A.D.	C. A. Richter, Wickepin
Bonzer	6 D.	M. Kelly, Isseka
Boxer	5 D.	J. Lloyd, Lake Biddy
Boxer	7 D.	V. H. Francis Lane, Three Springs
Brackenhurst Monarch	3 D.	H. E. Taylor & Sons, Dangin
Bradman	6 D.	A. F. H. Muir, Manjimup
Braeside Viceroy	3 D.	R. Kirkham, Yarloop
Bramley	3 D.	H. Mellersh, Yuna
Brilliant Stamp	5 D.	J. Franks, Lake Grace
Brilliant Starlight	7 T.	C. Draper, Duranillin
Broadview Winalot	7 D.	R. Carroll & Sons, York
Broxstead Lawyer	3 D.	J. MacCallum Smith, Perth
Brown Brilliant	A.D.	W. W. Clothier, Walgoolan
Bruce	7 D.	Beswick Bros., Yealering
Bruce	A.D.	T. Johnson, Yandanooka
Bruce Leader	7 D.	A. W. Douglas, Woodanilling
Buckland Major	3 D.	A. C. Wetters, Perenjori
Bulagin Major	7 D.	J. E. Peters, Wyalcatchem
Bullara Dale	7 D.	H. G. Johnston, Dangin
Bullaro Bandsman	5 D.	R. H. Wahlsten, Walgoolan
Caledonia	6 D.	M. Farrell, Perenjori
Captain	6 D.	W. Teakle, Isseka
Captain Kid	8 D.	R. P. Gaston, Koolanooka
Carngham Baron Jim	A.D.	McClarty Bros., Pinjarra
Carngham Bold	A.D.	R. James, Carnamah
Castle Ray	6 D.	C. L. Perry, Darkan
Champion Baron	6 D.	S. W. James, Karlgarin
Charlie	A.D.	A. J. Neal, Yelverton
Chief	3 D.	C. F. Mathews, Mumballup
Chronicle	7 T.	K. Cornish, Wandering
Claphamdale	7 D.	F. W. Wright & Co., Dalwallinu
Clifton Flashdale	7 D.	J. Harrod, Kununoppin
Clyde	3 D.	L. R. Martin, Williams
Clyde	6 D.	S. L. E. Lange, Popanyinning
Con of Buchlyvie	A.D.	M. J. Bennett, Lake Grace
Coorara Flash Ronald	4 D.	P. Falconer, Trayning
Cora Lyn	6 D.	T. W. Ward, Ballaying
Craig Lion	A.D.	A. H. Rathjen, Muntadgin
Craigie Emblem	6 D.	L. H. Lawrence, Northam
Craig Noble	6 D.	A. T. Zwar, Merredin
Culloden	5 D.	J. Watkins, Wagin
Culrain	5 D.	E. Williamson, Kondinin
Dale Kendale	3 D.	Mackay Bros., Tammin
Daliak Bute	3 D.	J. Gibson, Narrogin
Dalmeny Footstep	4 D.	A. Della, Wannamal
Dalmeny Middlerig	4 D.	M. G. Murray, Bowgada
Dalmeny Renown	A.D.	W. Jones, Walkaway
Dalmeny Style	4 D.	A. J. Hammatt, Buntine
Decorum	A. Tr.	W. R. B. Donnan, Tammin
Dixey Boy	4 Tr.	Mrs. V. T. N. Saggers, Tambellup
Donald Valetta	4 D.	L. J. Hilder, Narrogin

STALLION REGISTER, 1935-36—*continued.*

Name.	*Age and Class.	Owner and Address.
Don McDonald	A.D.	W. Stewart, Pithara
Doon Auchen Brae	5 D.	A. F. Bennett, Dumbleyung
Doon Auchen Craig	5 D.	J. H. Stone, Dangin
Doon Auchen Gift	3 D.	E. Bushalla, Narrogin
Doon Loch	4 D.	C. M. Campbell, Boyup Brook
Dora's Dunure	A.D.	Edgar Bros., Glentromie
Douglas Cobham	A.D.	W. Fraser, Dowerin
Dryfe Refiner	5 D.	Maughan Bros., Walgoolan
Duke	3 D.	E. W. Whittington, Brookton
Duke	3 D.	J. E. Mathews, Nungarin
Dunlop	4 D.	G. Goodall, Kojonup
Dunure's Pride	3 D.	J. B. Spurr, Karlgarin Hill
Earlstone	A.D.	R. T. Jenkins, Wagerup
Eastern Hero	5 D.	R. P. Wardle, Moora
Easy Tigne	5 Tr.	E. Somers, Trayning
Edenhope Beauty's Masterstroke	3 D.	J. H. Ferrier, Wickepin
Edward Middle March	4 D.	C. Avery, Wyalcatchem
Enfield Monarch	5 D.	C. Smith & Sons, Erikin
Eudamatch	A.T.	F. T. Carter, Tammin
Eureka Prince	4 D.	D. Negri, Bruce Rock
Eureka Stamp	3 D.	J. Litton, Moulyinning
Fairfield Royal Banker	7 D.	A. McD. Sargent, East Katanning
Fair Valley	5 D.	G. E. Carr, Beverley
Ferndale Briton	6 D.	A. J. Hill, Beverley
Fincairn Lad	4 D.	H. W. England, Perenjori
Flaming Star	7 T.	R. P. Bryant, Quairading
Flash Mac	A.D.	H. W. Treloar, Boyup Brook
Flash Pettadale	A.D.	J. Peden, Wagin
Flash Willie	4 D.	H. P. Jolly, Nungarin
Foxlow Stanley	6 D.	W. N. Hedges, Perth
Fyvielea Pearl	4 D.	Senator P. Lynch, Three Springs
Gallant Treasure	4 D.	H. Metcalf, Dowerin
Gallantry	A.D.	C. Lawler, Wongamine
Gay Baron	5 D.	E. Rose, Bunbury
Gay Boy	4 D.	H. Weaver, Beverley
Gay Spark	3 P.	W. B. Aked, Perth
Gigolo	6 T.	H. E. Vail, Herne Hill
Glenrowan	5 D.	A. E. Ray, Burracoppin
Golden Wheat	A.T.	A. E. Cockram, Belmont
Great Scott	4 D.	W. Linto, York
Greenlea Crystal	6 D.	C. J. Roberts, Dandarragan
Gumpark Favourite	A.D.	H. G. Bolt, Woodanilling
Hagley MacGregor	5 D.	Preston & Ryan, Tammin
Harold's Pride	4 D.	C. D. Williams, Boodarockin
Heather Lad	3 D.	D. Walker, Balingup
Homebush Chester	7 D.	R. W. Moodie, Westonia
Homebush Dandy	7 D.	T. Robinson, Pemberton
Homebush Jacko	5 D.	J. E. Nottle, Dulbelling
Homebush MacGregor	3 D.	J. MacCallum Smith, Perth
Homebush McDonald	3 D.	J. MacCallum Smith, Perth
Homebush Sampson	6 D.	J. Rogie, Pingelly
Howqua Dale	7 D.	J. O'Toole, Gnowangerup

STALLION REGISTER, 1935–36—*continued.*

Name.	*Age and Class.	Owner and Address.
Inverall Satisfaction	5 D.	H. F. Cooke, Tammin
Isle of Avon	2 T.	A. H. Mead, East Rockingham
Jennaberring Pride	3 D.	A. Veitch, Balkuling
Jimmy Douglas	4 D.	H. S. Riley, Trayning
Johnnie Walker	3 D.	H. H. Fleay, Darkan
Kaburnie Mac	3 D.	J. J. O'Brien, Mullewa
Kathleen Vale Style	5 D.	W. J. Pethick, Winchester
Kayanaba Don	4 D.	H. P. Halligan, New Norcia
Kayanaba Pilot	4 D.	T. W. Ward, Ballaying
Kildare	4 P.	Mrs. V. Cobbin, Subiaco
Killarney's Favourite	3 D.	J. Armstrong Estate, Wagin
King	6 D.	J. Grant, Perenjori
King Belmont	A.D.	H. J. Yelland, Bruce Rock
King Cole	5 D.	R. W. Mortimore, Wadderin Hill
King Edward	A.D.	W. Sherwood, Wyalcatchem
Koojan Flashlight	7 D.	W. Padbury, Three Springs
Koojan Prince Frederick ...	A.D.	J. Addison, Welbungin
Koojan Prince Royal	A.D.	W. W. Quartermaine, Katanning
Koojan Prince Norval	A.D.	A. E. Grant, Geraldton
Koorikin Pride	4 D.	W. J. B. Hawkins, Kondinin
Laddie	4 D.	H. Beard, Jennapullen
Laddie	A.D.	F. Bussell Vines, Busselton
La Fayette	A. Tr.	D. Stevenson, Moulyinning
Lakeside Bold Bute	A.D.	Shadbolt Bros., Mukinbudin
Lakeside Winalot	3 D.	R. Carroll & Sons, York
Lakeview Lothian	3 D.	H. Peiper, Lake Grace
Langi Masterpiece	3 D.	C. C. Smith, Three Springs
Leurgon Holton Honour ...	4 D.	H. Wornum & Sons, Tenterden
Lochiel	4 D.	J. T. Hill, Yealering
Longernong Dignity	7 D.	E. Williams, Northampton
Lord Banker	7 D.	A. W. Hewton & Sons, Minnivale
Lord Channler	4 D.	F. H. Sheen, Goomalling
Lord Charmer	8 D.	N. F. West, Wagin
Lord Lomon	A.D.	R. T. Wheatley, Bridgetown
Lord Patchem	A. Tr.	G. G. Sinclair, Toodyay
Lord Roseberry	A.D.	W. Morgan, Wagin
Lothian Gem	4 D.	S. & Y. Dowsett, Dwarda
Lothian Hero	4 D.	J. C. Summers, Capel
Lothian Pride	3 D.	R. Herron, Coolup
Lothian Prince	7 D.	G. S. Dayman, Emu Hill
Lothian Stamp	4 D.	Chambers Bros., Ravensthorpe
Loudoun Castle	2 D.	P. Strange, Yarding
Loudoun Duke	6 D.	A. Eldred, Salmon Gums
Loudoun Sensation	3 D.	J. J. Currie, Bruce Rock
Loudoun Stamp 2nd	7 D.	Growden Bros., Nangeenan
Lucky	5 D.	W. J. Drage, Mt. Barker
Lucky	3 D.	H. T. Richards, Morawa
Lyndhurst	8 D.	E. A. Ebsary, Wickepin
Mac	7 D.	H. W. Fitt, Narrogin
Mack	8 D.	G. E. Robins & Co., Babakin
Major Douglas	3 D.	R. Howie, Jibberding
Major Douglas	5 D.	J. Piggin, Trayning
Major Hillside	7 D.	E. R. Brown, Dumbleyung
Major Hurst	6 D.	M. Erhardt, Dowerin

STALLION REGISTER, 1935-36—*continued.*

Name.	*Age and Class.	Owner and Address.
Major Silverdale	3 D.	R. M. Jury, Nyabing
Major Valley	A.D.	H. A. Lupton, West Beverley
Marco Secundus	6 T.	C. R. Mitchell, Wagin
Marsonius II.	5 D.	Burgin & Yeamons, Wadderin Hill
Master Celtic	A. Tr.	H. Patroni, Donnybrook
Master Pilot	2 D.	G. Hatwell, Dowerin
McKie Prince	6 D.	W. H. Wright, Mandiga
Mendic	8 T.	Benedictine Community, New Norcia
Mick	3 D.	T. P. Duggan, Yericoin
Model Farm Pride	8 D.	J. A. W. Nicol, Mt. Barker
Mona Park Baron	A.D.	Wiese Bros., Highbury
Monsoon	A. Tr.	L. Burton, West Perth
Mookine Stamp	3 D.	V. L. Blight, Highbury
Moorlands Captain	8 D.	A. V. Moore, Doodlakine
Mortlock	2 D.	J. C. Carter, York
Mussolini	7 D.	H. H. Mazzuchelli, Gosnells
Nariel Banker	6 D.	L. J. Stacey, Quairading
Native Prince	5 D.	C. Scott, Bullfinch
Neumylda	A.T.	Penn Bros., Northampton
Newbold Belmont	4 D.	E. Ludeman, Wattening
Newfields Ambition	7 D.	C. G. & A. E. Nicholas, Gnowangerup
Newbold Emperor	5 D.	R. Carroll & Sons, York
Newbold Enterprise	8 D.	Craike Bros., Trayning
Newbold Pendant	4 D.	Prowse Bros., Doodlakine
Newfelds Sensation	5 D.	E. P. Young, Kondinin
Night Douglas	7 D.	W. J. Glen, Rivervale
Nililto Boy	6 D.	A. McCallum, Muntadgin
Nonsuch Style	8 D.	M. H. Erhardt, Dowerin
Nonsuch Style	A.D.	T. Pauley, Wickepin
Norward	3 D.	A. Jones, Dowerin
Nover	6 D.	C. D. McDonald, Redmond
Nugget	6 D.	B. L. Clarkson, Calingiri
Oakleigh Brown Kinloch	5 D.	H. Chivers, Yandanooka
Oaklyn Refiner	5 D.	V. G. Rennie, Gingin
Olympian	6 T.	F. A. Farquhar, Gingin
Patches	4 P.	J. H. Turner, Bunjil
Penryn Leader	5 D.	S. L. Folland, Waddy Forest
Perfect Hero	3 D.	R. S. Parnell, Gnowangerup
Peter Baron	6 D.	J. J. Weinert, Narrogin
Peter McCormack	4 D.	Mrs. M. E. Perrin, Toodyay
Peter Pan	3 D.	W. T. Poole, Kondinin
Peter's Pride	7 D.	D. McLean (Jun.), Lake Camm
Peter Stretta	A. Tr.	Dr. A. Juett, Perth
Peter of Triagen	7 D.	W. Potthoff, Kondinin
Peter Voyager	A. Tr.	W. Pratt, Muntadgin
Pilot	6 D.	F. J. Ridge, Morawa
Pinevale Peter	3 D.	Mrs. R. G. Dayman, Kwelkan
Premier Willie	D.	Wiese Bros., Highbury
Pride	3 D.	I. J. Thornton, Bullaring
Pride	8 D.	W. Mullan, Harrismith
Prince	3 D.	A. Bateman, Three Springs
Prince	3 D.	Sim Bros., Yealering
Prince	3 D.	A. T. Sloan, East Rockingham
Prince	6 D.	A. Piesse, Wagin
Prince Aubry	5 D.	C. H. Georgy, Kalannie
Prince Avon	4 D.	W. J. Treloar, Boyup Brook

STALLION REGISTER, 1935-36—*continued.*

Name.	*Age and Class.	Owner and Address.
Prince Belmont	6 Tr.	A. J. Reither, Pingelly
Prince Bold	6 D.	H. W. England, Bowgada
Prince Charlie	6 D.	C. Whittington, Brookton
Prince Derby	A. Tr.	R. Carroll, York
Prince Favourite	A.D.	T. Norrish, Kojonup
Prince Gilikin	5 D.	A. C. Carter, Williams
Prince Kerrston	8 D.	Black Bros., Harvey
Prince Loman	5 D.	G. Fontanini, Manjimup
Prince Paladin	4 D.	S. King, Goomalling
Prince Robert	6 D.	L. Brissenden, Muntadgin
Proctor	A.T.	J. A. Barry, Redcliffe
Punch	3 D.	D. Dowie, Boyup Brook
Punch	6 D.	T. G. & J. Maughan, Nukarni
Radiant	6 D.	F. P. Atwell, Toodyay
Ringswood Don	5 D.	P. B. Stirling, Pemberton
Robin	A.D.	H. Hamersley, Wagin
Rockwell Marshall	2 D.	T. G. McGellin, Belka
Roselock	4 D.	T. H. Leake, Kellerberrin
Roselyn Master	6 D.	R. Carroll & Sons, York
Roselyn Radiant	4 D.	Yarragadee-Nalbarra Pastoral Co., Mingenew
Rosemont	A.D.	W. K. Miller, Donnybrook
Roselyn Boy	3 D.	A. J. Flanagan, Bunbury
Roselyn Douglas Viceroy ...	A.D.	Beiker Bros., Wagin
Rotanic	3 T.	R. J. Hodgson, Minnivale
Rothsay Prince Craig	4 D.	W. G. Argent, Kulin
Rowdy	5 D.	C. Eyden, Highbury
Roy	6 D.	G. H. Jones, Yandanooka
Royal Appotenic	4 D.	H. H. Stafford, South Karlgarin
Royal Favour	3 D.	L. J. Hilder, Narrogin
Royal Prince	5 D.	W. A. T. Sargent, Carnamah
Royal Star	A.D.	G. Irving, Cranbrook
Sandy Mac	3 D.	R. Donald, Yuna
Sansofine	3 T.	A. E. Cockram, Belmont
Schevvilleure Librarian	7 D.	J. Harrod, Kununoppin
Scotch Willie II.	5 D.	J. H. Price, Narembeen
Sea Crest	A.T.	L. W. Viveash, Northam
Sedalia Douglas	6 D.	T. G. McGellin, Belka
Sheik	A. Tr.	W. P. Baker, North Perth
Silver Bold	6 D.	Wilhelm & Sons, Woodanilling
Silverdale	A.D.	C. D. Garston, Woodanilling
Simpson's Earl	A.D.	W. C. Simpson, Round Hill
Sir James	A.D.	E. Vanzetti, Marchagee
Sir Walter Raleigh	6 D.	W. J. Bowers, Gingin
Some Scotch	8 D.	R. J. M. Fairclough, Kwobrup
Sorania	A.T.	Mt. Augustus Pastoral Co., Meekatharra
Spats	8 Tr.	Cowder Bros., Williams
Star	5 D.	D. Gunn & Son, Kellerberrin
Sunflower	5 D.	J. L. Ward, Nippering
Sunnylands Craig Fashion ...	6 D.	J. M. Young, Gwambygine
Sunnyside Alick	8 D.	Page Bros., West Pingelly
Sunny Style	3 D.	F. Packham, Tammin
Tandarra Baron	8 D.	G. Ferrier, Mingenew
Tandarra Earl	3 D.	J. Tolley, Doodlakine
Taunton Robin Adair	5 D.	S. O. Argent, Lake Grace
Thomond Yet	3 D.	P. J. McMahon, Lake Grace
Tiger	6 D.	L. M. Baikie, Quairading

STALLION REGISTER, 1935-36—*continued.*

Name.	*Age and Class.	Owner and Address.
Tipperary	6 D.	R. H. Fulwood, Cunderdin
Treat	A.T.	H. E. Vail, Herne Hill
Trooper	7 D.	G. J. Butterworth, Katanning
Tynedale Flashlight	3 D.	J. Lampard, Waddy Forest
Tynedale Kenwyn Again ...	4 D.	H. J. Wise, Katanning
Valerano	A.T.	Benedictine Community, New Norcia
Valetta Ramon	5 D.	W. H. Creek, Corrigin
Valetta Royal Hero	4 D.	E. Raynor, Dalwallinu
Veradale Roderick	4 D.	W. Waddell, Walgoolan
Victor	3 D.	A. T. Walker, Beverley
Victoria Shamrock	7 D.	S. B. Ruddick, Coorow
Victory Star	5 D.	G. W. Smith, Corrigin
Viking	...	A. E. Clarke, Goomalling
Wallad	6 Ar.	C. C. Readhead, Mingenew
War Dance II.	6 D.	P. Briotti, Koorda
War Dance III.	4 D.	Ferguson Bros,. Koorda
War Dolan	7 D.	Mrs. M. E. Miller, Mandiga
War General	7 D.	C. A. Sweeting, Tammin
Wattle Grove Gaylad	8 D.	A. M. Day, Burracoppin
Wattle Valley Bold Boy ...	4 D.	W. C. Roberts, Mt. Madden
Wattle Valley Rosemont Again	7 D.	E. J. & D. S. Biglin, Karlgarin
Wattle Valley Stamp	A.D.	H. G. Ebsary, Wickepin
Wendale	3 D.	A. Johnston, Gnowangerup
Wendourie Auchenflower ...	5 D.	P. J. Collins, Tambellup
Werndew Flashlight	7 D.	J. Carruthers, Lake Grace
Werndew Stockwell	3 D.	L. M. Fletcher, Belka
Werndew Squire	4 D.	H. W. Biglin, Kondinin
Werrup Pride	4 D.	L. C. Cusbert, Bruce Rock
West Wimmera	7 D.	W. G. Hallam, Red Lake
Widgiewa Pete	3 D.	W. T. Hobbs, Beverley
Wilfred	A. Tr.	W. P. Baker, East Perth
Woolamia Mark	3 D.	J. & H. B. Rinaldi, Kalannie
Woolie	A.D.	J. Thomson, Donnybrook
Wrayton Duke	3 D.	J. Knox, Lake Yealering
Wrayton Mark	3 D.	J. E. Bates, Boddington
Yadlock	3 T.	D. C. Pearce, Kojonup
Yodelist	A.T.	H. H. Roberts, Capel

GREEN BUG EGG PARASITE.

(*Microphanurus megacephalus.*)

It is pleasing to be able to record that this tiny egg parasite has negotiated the second winter in this State and has appeared again in force this spring.

Wherever the parasite is established, the green bug population is greatly reduced. There are still portions of the South-West where the bug is prevalent, no parasites having yet been liberated.

To assist in the breeding of the parasite for distribution, growers are requested to forward green bug eggs to the Entomologist, Department of Agriculture, Perth. In return for the eggs, parasites, if required, will be supplied.

BREEDING EWES.

THE IMPORTANT MATTER OF SELECTION.

Hugh McCallum,
Sheep and Wool Inspector, Department of Agriculture.

There are many farmers who do not realise the importance of the ewe in building up a flock to the ideal aimed at by the breeder. It is essential that they should be carefully selected for their requisite qualities. Leading characteristics which a ewe should possess are, first and foremost, constitution, conformation, trueness to type, vitality, fertility, and good bone.

The following are detailed points of a good serviceable ewe that can be purchased, off shears, every year from the leading breeders in the State:—

A well-shaped head; a broad and full forehead; clean open face; a mouth without defect; neck of fair length to enable the animal to feed comfortably, being well set in at the shoulders and tapering to the head; shoulders full and deep, with a good depth and width through from shoulder to shoulder to give plenty of room inside for the vital organs to do their work properly; withers full and rounded, the back even and straight and not too long; good bone in the legs; strong springy pasterns, good hocks and fetlocks. Constitution is the foundation of the animal.

PROGENY AND FERTILITY.

When both ewes and rams are selected, with proper regard to strong robust constitutions, this characteristic is disseminated throughout the flock, and results in strong, healthy progeny, if the holding is not overstocked or the flock underfed. A study of the pastures is essential and the progress of the stock must be watched. With sound vitality, the ewes can stand reverses, but should be looked after, especially during gestation and at lambing-time.

Fertility is essential; no ewe that has failed to produce lambs should be on the farm. There are too many unproductive ewes retained on the farms, year after year, for reasons difficult to understand.

If the ewes are not classed every year the undesirable sheep will retard the flock's improvement. Ewes with any of the following faults should be culled out:—Broken or defective mouth; weak constitution; showing the grip; scraggy necked; weak shoulders; slab-sided; narrow hindquarters; thin bone; tucked-up appearance or deformed sheep; and all animals growing wool that is uneven, dull, yellow-coloured, heavy conditioned, or very short in length of staple.

In building up a flock every endeavour should be made to secure a good line from a well-known sheepbreeder, off shears, known as cast for age ewes of sound mouth (not cull ewes). Broken-mouthed sheep, even though they are cheap, should never be purchased, as they are always a trouble to the purchaser. It is wise not to bargain unduly over the price required by the vendor, bearing in mind the time, cost and work involved in breeding up a high-grade uniform flock. By starting on sound lines many years of patient work in selecting, mating, and culling are saved; besides the usual disappointments the breeder experiences. Success or failure will then depend entirely on the farmer's own ability in selecting the rams required, mating them with the most suitable ewes, feeding the flock (a most important part of sheep husbandry that must not be neglected), and in attending to the ewes during the gestation period and at lambing-time.

CULLING, SELECTION AND MATING.

Should the farmer purchase ewes at the sale yards, he should be there early in order to have ample time to go through the different lines to be submitted. There may be several lines on offer not suitable to the particular class of country for which they are required. Many buyers of sheep do not examine the lots they are likely to purchase; more attention should be given to this.

There will always be sheep that require to be rejected from purchases made at sales. These sheep should be picked out and fattened as speedily as possible and sold for mutton. The flock will thus be made more uniform.

Before the flock of ewes is shorn, there is another opportunity for culling when they are carrying their full fleece. The ewe hoggets should be culled heavily, and any ewe about which there is any doubt should be rejected. It is upon the young ewes that the farmer is depending to build up his flock to be a credit to himself and the State.

Western Australia is fortunate in having many enthusiastic studbreeders, and it is largely to the work of these men that the sheep industry owes its success.

Thousands of pounds have been spent in the purchase of the highest grade sheep for breeding purposes, and by skill and perseverance they have built up flocks of a high standard. From them the ordinary farmer can procure sheep from which, by careful selection and mating, he can breed up a high-grade flock or improve his existing one.

WHEAT VARIETIES IN WESTERN AUSTRALIA.

R. P. Roberts,
Agricultural Adviser, Department of Agriculture.

The following table shows the acreages of the more important varieties of wheat sown in Western Australia for the seasons 1934-35 and 1935-36. The acreage figures, which were supplied by the Government Statistician, were obtained when the acreage forecasts were collected in August of each year. Similar figures for the four preceding seasons were published in the "Journal of Agriculture" for March, 1934.

1934–35.				1935–36.			
Variety.	Position.	Acreage (000's)	Approximate percentage of total.	Variety.	Position.	Acreage (000's).	Approximate per centage of total
Bencubbin	1	649	22·5	Bencubbin	1	840	30·7
Gluyas Early ...	2	382	13·2	Gluclub	2	302	11·3
Nabawa	3	328	11·4	Merredin	3	285	10·5
Gluclub	4	317	11·0	Gluyas Early ...	4	251	9·3
Merredin	5	312	10·9	Nabawa	5	229	8·0
Noongaar	6	167	5·7	Noongaar	6	130	4·6
Waratah	7	121	4·2	Totadgin	7	121	4·3
Bena	8	98	3·4	Waratah	8	98	3·4
Geeralying	9	63	2·2	Ford	9	59	2·3
Ford	10	62	2·1	Bena	10	58	2·2
Gallipoli	11	53	1·9	Geeralying	11	48	1·7
Canberra	12	43	1·5	Gallipoli	12	45	1·6
Totadgin	13	42	1·5	Baroota Wonder ...	13	41	1·5
Baroota Wonder ...	14	40	1·4	Canberra	14	24	1·0
Gresley	15	29	1·0	Gresley	15	23	0·9
Yandilla King ...	16	18	0·6	Sword	16	16	0·7
Rajah	17	14	0·5	Rajah	17	13	0·5
Federation	18	12	0·4	Sutton	18	12	0·4
Bald Early ...	19	12	0·4	Yandilla King ...	19	12	0·4
Felix	20	11	0·4	Bald Early ...	20	11	0·4
All other varieties ...		110	3·8	Rance	21	11	0·4
				All other varieties ...		106	3·9
Total		2,883	100	Total		2,735	100

"Nabawa" has declined from first place in 1933-34, with 18 per cent. of the total area sown, to fifth place in 1935-36, with 8.0 per cent. of the total cropped area.

"Bencubbin," as anticipated, advanced to first place in 1934-35 with 649,000 acres (22.5 per cent.) Despite a setback due to the rust outbreak in 1934, 840,000 acres were planted the following season, representing 30.7 per cent. of the area under crop.

The two early maturing varieties, "Gluyas Early" and "Merredin," have lost ground due partly to the increasing popularity of the flag smut resistant early maturing variety "Totadgin," which has increased from 2,000 acres and 39th place in 1933-34 to 121,000 acres and 7th place in 1935-36. The decline in acreage of these two varieties has resulted in "Gluclub" moving into second place, despite a slight decrease in the area sown in 1935-36 as against 1934-35.

Due no doubt to the fact that in 1934-35 millers were prepared to pay up to 1s. per bushel premium for higher quality wheats, the area under these varieties showed a slight increase in 1935-36, advancing from 0.8 per cent. of the total to 1.2 per cent. A further increase can be anticipated in the future, providing that the same inducement is offered to farmers.

Of the total area cropped during the past year, approximately 62 per cent. was sown with varieties produced by the Department of Agriculture.

FERTILISERS.

N. DAVENPORT,
Inspector of Fertilisers.

In accordance with the Fertilisers Act, 1928, the list of fertilisers registered for the present fertiliser year, which commenced on 1st November, is appended in tabular form.

From the retail prices per ton and the registered fertilising ingredients present in the fertilisers, the unit values for the different forms of nitrogen, phosphoric acid and potash have been calculated and are shown below together with those of 1933-34 and 1934-35 for comparison.

UNIT VALUES.

	1933–34.	1934–35.	1935–36.
	s. d.	s. d.	s. d.
NITROGEN (N) as—			
Blood and Bone, Bonedust and Bone and Flesh	23 0	22 0	22 0
Nitrate	19 11	19 7	18 3
Ammonia	12 4	12 3	11 8
PHOSPHORIC ACID (P_2O_5) as—			
Water Soluble as Superphosphate	3 11	3 9	3 5
Citrate Soluble as Superphosphate	3 11	3 9	3 5
In Bonedust	5 9	5 9	5 9
In Blood and Bone and other animal fertilisers	5 3	5 3	5 9
Basic Phosphate	5 6	5 4	5 1
Acid Soluble in Superphosphate and Rock Phosphate	2 6	2 4	2 2
POTASH (K_2O) as—			
Sulphate	8 5	6 4	6 0
Muriate	6 7	5 0	5 0

The following fertilisers are registered at the Department of Agriculture under the Fertilisers Act, 1928, for the year commencing 1st November, 1935:—

Name of Fertiliser.	Brand.	By whom Registered.	Nitrogen (N) as:				Phosphoric Acid (P_2O_5) as:				Potash (K_2O) as:		Price per ton on rails at Works or Perth.
			Nitrate.	Ammonia.	Blood & Bone.	Bone-dust.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Total.	Sulphate.	Muriate.	
A.—MINERAL.			%	%	%	%	%	%	%	%	%	%	£ s. d.
1.—NITROGENOUS.													
(a)—Nitrogen as Nitrate.													
Nitrate of Soda	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	15·5	...	...	...	...	...	...	...	...	...	14 0 0
Do.	ML in diamond ...	do. do.	15·5	...	...	...	...	...	...	...	...	...	14 0 0
Do.	CSML	do. do.	15·5	...	...	...	...	...	...	...	...	...	14 0 0
Do.	Cresco	Cresco Fertilisers (W.A.), Ltd.	15·0	...	...	...	...	...	...	...	...	...	14 2 6
(b)—Nitrogen as Ammonia.													
Sulphate of Ammonia ...	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	20·5	...	...	...	...	...	...	...	...	12 0 0
Do.	ML in diamond ...	do. do.	...	20·5	...	...	...	...	...	...	...	...	12 0 0
Do.	CSML	do. do.	...	20·5	...	...	...	...	...	...	...	...	12 0 0
Do.	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	20·0	...	...	...	...	...	...	...	...	11 10 0
Do.	ICI in circle ...	F. Viles	...	...	...	...	...	...	...	...	...	...	...
2.—PHOSPHATIC.													
(a)—Rock Phosphates.													
Pacific Islands Phosphate ...	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	...	...	...	...	36·65	36·65	...	...	4 0 0
Do. do. ...	ML in diamond ...	do. do.	...	...	...	...	...	...	36·65	36·65	...	...	4 0 0
Do. do. ...	CSML	do. do.	...	...	...	...	...	...	36·65	36·65	...	...	4 0 0
Phosphate Powder ...	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	...	...	...	...	34·80	34·80	...	...	3 15 0
(b)—Superphosphates.													
Florida Super (22%) ...	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	...	...	20·5	·5	1·0	22·0	...	...	3 15 0
High Grade Super (22%) ...	ML in diamond ...	do. do.	...	...	...	...	20·5	·5	1·0	22·0	...	...	3 15 0
Do. do. ...	CSML	do. do.	...	...	...	...	20·5	·5	1·0	22·0	...	...	3 15 0
22 Super	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	...	...	20·5	·5	1·0	22·0	...	...	3 15 0
Florida Super (24%) ...	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	...	...	22·0	·5	1·5	24·0	...	...	4 0 0
High Grade Super (24%)	ML in diamond ...	do. do.	...	...	...	...	22·0	·5	1·5	24·0	...	...	4 0 0
Do. do. ...	CSML	do. do. ...	...	...	...	...	22·0	·5	1·5	24·0	...	...	4 0 0
24 Super	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	...	...	22·0	·5	1·5	24·0	...	...	4 0 0

(c)—Rock Phosphates and Superphosphate.												
Phosphate Mixture (50/50)	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	...	...	10·0	·50	18·50	29·0	...	...	4 2 6
Do. do. ...	ML in diamond ...	do. do.	...	...	...	...	10·0	·50	18·50	29·0	...	...	4 2 6
Do. do. ...	CSML	do. do.	...	...	...	...	10·0	·50	18·50	29·0	...	...	4 2 6
50/50 Phosphate	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	...	...	9·16	1·84	17·40	28·4	...	...	4 2 6
(d)—Basic Phosphate.												
Basic Phosphate	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	...	...	...	...	17·0	17·0	...	...	4 6 0
Do.	ML in diamond ...	do. do.	...	...	...	...	...	...	17·0	17·0	...	...	4 6 0
Do.	CSML	do. do.	...	...	...	...	...	...	17·0	17·0	...	...	4 6 0
3.—Potassic.												
(a) Potash as Sulphate.												
Sulphate of Potash ...	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	...	...	...	...	...	...	48·60	...	14 10 0
Do.	ML in diamond ...	do. do.	...	...	...	...	...	...	...	...	48·60	...	14 10 0
Do.	CSML	do. do.	...	...	...	...	...	...	...	...	48·60	...	14 10 0
Do.	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	...	...	...	...	...	...	48·50	...	14 10 0
Do.	Sun	Westralian Farmers, Ltd.	...	...	...	...	...	...	...	...	48·60	...	14 10 0
(b) Potash as Muriate.													
Muriate of Potash	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	...	...	...	...	...	...	...	50·0	12 10 0
Do.	ML in diamond ...	do. do. ...	...	...	...	...	...	...	...	...	...	50·0	12 10 0
Do.	CSML	do. do. ...	...	...	...	...	...	...	...	...	...	50·0	12 10 0
Do.	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	...	...	...	...	...	...	...	50·0	12 10 0
Do.	Sun	Westralian Farmers, Ltd.	...	...	...	...	...	...	...	...	...	50·0	12 10 0
Kainit	do.	do. do.	...	...	...	...	...	...	...	...	...	14·0	*
Potash Manure Salts ...	do.	do. do	...	...	...	...	...	...	...	...	...	30·0	*
4.—Nitrogen and Phosphoric Acid.													
Super and Ammonia (2 & 1)	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	6·87	...	...	13·66	·34	·66	14·66	...	...	7 2 6
Do. do. (3 & 1)	do.	do. do.	...	5·15	...	...	15·37	·37	·76	16·50	...	...	6 10 0
Do. do. (6 & 1)	do.	do. do.	...	2·94	...	...	17·57	·43	·85	18·85	...	...	5 12 6
Do. do. No. 1	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	2·94	...	...	17·57	·43	·85	18·85	...	...	5 12 6
Do. do. No. 2	do.	do. do.	...	5·15	...	...	15·37	·37	·76	16·50	...	...	6 10 0
Do. do. No. 3	do.	do. do.	...	6·0	...	...	14·25	·40	1·10	15·75	...	...	6 15 0
Do. do. No. 4	do.	do. do.	...	6·87	...	...	13·66	·34	·66	14·66	...	...	7 2 6
Potato Manure C	do.	do. do.	...	3·50	...	...	16·75	·40	1·10	18·25	...	...	5 17 6
Do. F	do.	do. do.	...	6·0	...	...	14·25	·40	1·10	15·75	...	...	6 15 0

* Prices not available.

FERTILISERS—*continued.*

Name of Fertiliser.	Brand.	By whom registered.	Nitrogen (N) as:				Phosphoric Acid (P_2O_5) as:				Potash (K_2O) as:		Price per ton on rails at Works or Perth.
			Nitrate.	Ammonia.	Blood & Bone.	Bone-dust.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Total.	Sulphate.	Muriate.	
4.—NITROGEN AND PHOSPHORIC ACID.—*continued.*			%	%	%	%	%	%	%	%	%	%	£ s. d.
Super and Ammonia, No. 1	ML in diamond ...	Cuming Smith Mt. Lyell F.F., Ltd.	...	2·94	...	...	17·57	·43	·85	18·85	...	...	5 12 6
Do. do. No. 2	do. do. ...	do. do.	...	5·15	...	...	15·37	·37	·76	16·50	...	...	6 10 0
Do. do. No. 3	do. do. ...	do. do.	...	6·0	...	...	14·25	·40	1·10	15·75	...	...	6 15 0
Do. do. No. 4	do. do. ...	do. do.	...	6·87	...	...	13·66	·34	·66	14·66	...	...	7 2 6
Potato Manure, No. 2 ...	do. do. ...	do. do.	...	3·50	...	...	16·75	·40	1·10	18·25	...	...	5 17 6
Do. No. 6 ...	do. do. ...	do. do.	...	6·0	...	...	14·25	·40	1·10	15·75	...	...	6 15 0
Super and Ammonia, No. 1	CSML	do. do.	...	2·94	...	...	17·57	·43	·85	18·85	...	...	5 12 6
Do. do. No. 2	do.	do. do.	...	5·15	...	...	15·37	·37	·76	16·50	...	...	6 10 0
Do. do. No. 3	do.	do. do.	...	6·0	...	...	14·25	·40	1·10	15·75	...	...	6 15 0
Do. do. No. 4	do.	do. do.	...	6·87	...	...	13·66	·34	·66	14·66	...	...	7 2 6
Potato Manure C	do.	do. do.	...	3·50	...	...	16·75	·40	1·10	18·25	...	...	5 17 6
Do. F	do.	do. do.	...	6·0	...	...	14·25	·40	1·10	15·75	...	...	6 15 0
5.—NITROGEN, PHOSPHORIC ACID AND POTASH.													
Special Mixture 67 ...	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	4·0	...	...	15·0	...	1·0	16·0	2·40	...	6 12 6
Vine Manure	do.	do. do.	...	1·50	...	...	7·10	1·40	13·50	22·0	7·50	...	6 15 0
Mixed Manure	do.	do. do.	...	1·50	...	...	7·10	1·40	13·50	22·0	7·50	...	6 15 0
Orchard Manure	do.	do. do.	...	1·50	...	...	7·10	1·40	13·50	22·0	7·50	...	6 15 0
Special Orchard Manure ...	do.	do. do.	...	8·34	...	...	8·40	·20	·40	9·0	...	10·04	9 12 6
Potato Special	do.	do. do.	...	4·0	...	...	12·50	·50	·75	13·75	8·75	...	8 2 6
Potato Manure	do.	do. do.	...	1·50	...	...	7·10	1·40	13·50	22·0	7·50	...	6 15 0
Potato Manure B	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	3·75	...	...	14·50	·35	·75	15·60	4·50	...	7 1 0
Do. E	do.	do. do.	...	3·50	...	...	14·0	·30	·70	15·0	8·0	...	7 16 0
Do. G	do.	do. do.	...	3·50	...	...	10·50	·20	·60	11·30	16·0	...	9 13 0
Do. H	do.	do. do.	...	4·0	...	...	12·70	·30	·70	13·70	9·0	...	8 5 0
Do. No. 5 ...	do.	do. do.	...	7·50	...	...	7·0	·20	·40	7·60	13·25	...	10 12 0
Orchard Manure	do.	do. do.	...	2·0	...	...	15·75	·40	1·10	17·25	...	5·0	6 5 0
Special Mixture K ...	do.	do. do.	...	8·34	...	...	8·40	·20	·40	9·0	...	10·04	9 12 6
Do. KP ...	do.	do. do.	...	6·34	...	...	10·50	·20	·80	11·50	10·04	...	9 7 0
Tobacco Fertiliser	do.	do. do.	...	3·30†	...	...	14·0	·50	1·0	15·50	5·70	...	7 9 0
Potato Manure, No. 3 ...	ML in diamond ...	do. do.	...	3·75	...	...	14·50	·35	·75	15·60	4·50	...	7 1 0
Do. No. 4 ...	do. do. ...	do. do.	...	3·50	...	...	14·0	·30	·70	15·0	8·0	...	7 16 0
Do. No. 7 ...	do. do. ...	do. do.	...	3·50	...	...	10·50	·20	·60	11·30	16·0	...	9 13 0
Do. No. 8 ...	do. do. ...	do. do.	...	4·0	...	...	12·70	·30	·70	13·70	9·0	...	8 5 0
Do. No. 5 ...	do. do. ...	do. do.	...	7·50	...	...	7·0	·20	·40	7·60	13·25	...	10 12 0
Orchard Manure	do. do. ...	do. do.	...	2·0	...	...	15·75	·40	1·10	17·25	...	5·0	6 5 0
Special Mixture K ...	do. do. ...	do. do.	...	8·34	...	...	8·40	·20	·40	9·0	...	10·04	9 12 6
Do. KP ...	do. do. ...	do. do.	...	6·34	...	...	10·50	·20	·80	11·50	10·04	...	9 7 0
Tobacco Fertiliser	do. do. ...	do. do.	...	3·30†	...	...	14·0	·50	1·0	15·50	5·70	...	7 9 0

Potato Manure B	CSML	Cuming Smith Mt. Lyell F.F., Ltd.	...	3·75	...	...	14·50	·35	·75	15·60	4·50	...	7 1 0
Do. E	do.	do. do.	...	3·50	...	...	14·0	·30	·70	15·0	8·0	...	7 16 0
Do. G	do.	do. do.	...	3·50	...	...	10·50	·20	·60	11·30	16·00	...	9 13 0
Do. H	do.	do. do.	...	4·0	...	...	12·70	·30	·70	13·70	9·0	...	8 5 0
Do. No. 5 ...	do.	do. do.	...	7·50	...	...	7·0	·20	·40	7·60	13·25	...	10 12 0
Orchard Manure	do.	do. do.	...	2·0	...	...	15·75	·40	1·10	17·25	...	5·0	6 5 0
Special Mixture K ...	do.	do. do.	...	8·34	...	...	8·40	·20	·40	9·0	...	10·04	9 12 6
Do. KP ...	do.	do. do.	...	6·34	...	...	10·50	·20	·80	11·50	10·04	...	9 7 0
Tobacco Fertiliser † ...	do.	do. do.	...	3·30	...	...	14·0	·50	1·0	15·50	5·70	...	7 9 0
G.—MISCELLANEOUS.													
Sulphate of Iron	Sickle	do. do.	...	...	...	...	...	...	...	...	...	...	11 1 6
Do.	ML in diamond ...	do. do.	...	...	...	...	...	...	...	...	...	...	11 1 6
Do.	CSML	do. do.	...	...	...	...	...	...	...	...	...	...	11 1 6
Super and Manganese † ...	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	...	...	17·0	·50	1·0	18·50	...	...	7 10 0
B.—ORGANIC.													
(a)—Blood and Bone.													
Blood and Bone	Wyndham	Wyndham Meat Works	...	...	6·0	...	...	8·50	7·75	16·25	...	...	9 15 0
Do.	A1	Haynes & Clements	...	...	5·25	...	...	3·0	9·0	12·0	...	...	11 0 0
Do.	A.N.A. Surprise ...	C. A. Kirkby & Son	...	...	5·0	...	...	4·0	14·0	18·0	...	...	9 15 0
Do.	Apollo	J. Kitchen & Sons	...	...	5·25	...	...	3·0	12·0	15·0	...	...	9 10 0
Do.	Eclipse	W.A. Meat Exports Co.	...	...	6·0	...	...	...	12·0	12·0	...	...	8 15 0
Do.	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	5·50	...	...	...	14·0	14·0	...	...	9 15 0
Do.	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	6·0	...	...	...	12·0	12·0	...	...	9 10 0
Do.	ML in diamond ...	do. do.	...	...	6·0	...	...	...	12·0	12·0	...	...	9 10 0
Do.	CSML	do. do.	...	...	5·0	...	...	...	15·0	15·0	...	...	10 0 0
(b)—Bones.													
Bonedust	W in diamond ...	Henry Wills & Co.	...	...	...	2·75	...	6·0	13·0	19·0	...	...	9 0 0
Do.	Eclipse	W.A. Meat Exports Co.	...	...	...	3·50	...	...	22·0	22·0	...	...	9 5 0
Pure Bondust	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	...	3·50	...	...	22·0	22·0	...	...	10 5 0
Bonedust	CSML	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	...	3·50	...	...	22·0	22·0	...	...	11 0 0
(c)—Other.													
Nil	... ...	... ...	...	...	...	...	...	...	...	...	...	...	...

† Contains 5·75% Manganese as MnO_2.

FERTILISERS—*continued.*

Name of Fertiliser.	Brand.	By whom Registered.	Nitrogen (N) as:				Phosphoric Acid (P_2O_5) as:				Potash (K_2O) as:		Price per ton on rails at Works or Perth.
			Nitrate.	Ammonia.	Blood & Bone.	Bone-dust.	Water Soluble.	Citrate Soluble.	Acid Soluble.	Total.	Sulphate.	Muriate.	
C.—MINERAL AND ORGANIC.			%	%	%	%	%	%	%	%	%	%	£ s. d.
Bone and Super	Sickle	Cuming Smith Mt. Lyell F.F., Ltd.	...	...	...	2·0	13·0	·80	4·70	18·50	...	...	6 14 0
Do.	ML in diamond ...	do. do.	...	...	...	2·0	13·0	·80	4·70	18·50	...	...	6 14 0
Do.	CSML	do. do.	...	...	...	2·0	13·0	·80	4·70	18·50	...	...	6 14 0
Bone, Super and Potash ...	Cresco	Cresco Fertilisers (W.A.), Ltd.	...	...	...	1·0	...	...	14·0	14·0	1·0	...	4 17 6
Domestic Garden, No. 1 ...	Wondergrowth ...	W. J. Mathews ...	...	...	3·75	...	12·0	·30	3·20	15·50	...	...	*

* Sold in small lots.

CLEAN MILK COMPETITION.

BALINGUP CHEESE FACTORY, 1934-35.

M. Cullity,
Senior Agricultural Adviser, Dairy Branch.

The Balingup Clean Milk Competition was inaugurated in September, 1934, by Mr. R. G. Lock, who offered a prize of £10 to the supplier of milk of the best keeping quality. This competition was the first to be organised in Western Australia and very good results have been obtained. The facilities available necessitated that the decision be based on practical factory tests. The writer was asked to adjudicate and was responsible for the system adopted.

The Methylene Blue Reductase and the Sediment tests were used as the basis of the examination. The Fermentation and Modified Alcohol tests were used to obtain further information and as a check on the preceding ones. Further, on the final inspection a number of samples were examined microscopically and confirmed the conclusions formed from the factory tests.

The Balingup district—up to the time of the establishment of the cheese factory in January, 1934—was a cream or butter-fat supplying area. The farms are comparatively scattered and transport had to be organised in order that supplies would reach the factory at a reasonable hour. One collection per day is made, so the night and morning milks are delivered at the same time and are mixed in the same vat for manufacture. The number of suppliers to the factory was approximately 40 during the flush period of the year, but diminished to 25 by the middle of February. Deliveries are made from a distance of 10 miles, and milk is received at the factory from 7.30 a.m. to 10 a.m.

The quality of the cows and the methods of the farmers are very similar to those throughout the South-West, and the information gained regarding the quality of the milk may be considered as a reflection of the average conditions and methods under which milk is being produced.

It was decided to make three visits at approximately monthly intervals, so that consistency in maintaining quality would be necessary for the prize winner. Accordingly inspections were carried out on the following dates:—

20th November, 1934.
22nd January, 1935.
11th February, 1935.

For the purpose of allowing each supplier the same degree of preparedness for having the milk examined, it was considered essential that samples be taken unexpectedly, that is, suppliers would have no knowledge as to when the samples would be taken, and so could not prepare a specially clean milk for the day of examination only. This purpose was achieved by arriving—without previous advice even to the manager—in the early morning before the delivery of milk commenced.

A sediment disc and two samples were taken from the milk from each supplier. The Methylene Blue and Fermentation tests were carried out and results tabulated according to the results.

This was the procedure for each inspection, the total points for each being added to obtain the final result, which showed the prize winner to be Mr. H. Scarr, followed closely by Messrs. H. Menhennett and C. Russell in second and third places respectively.

The following tables should give some idea of the information gained.—

Table 1.—METHYLENE BLUE ANALYSIS.

Summary of the three Inspections.

Inspection.	Under 1 hour.	2 hours.	3 hours.	4 hours.	5 hours.	6 hours.	7 hours.	Over 7 hours.
1st	15	9	4	3	6	1	...	...
2nd	...	...	2	1	2	1	...	25
3rd	1	1	5	2	2	6	3	5

It will be noticed that on the second inspection a really remarkable improvement was shown. However, it is felt that the extent of this improvement, which is beyond even that of the third inspection, is due to the particularly cold night experienced just prior to this visit. This was one of the coldest nights of the summer and, as a consequence, milk cooled to a fairly low temperature and so the overnight development of bacteria was retarded. The third visit followed a comparatively hot night and so the reverse condition was operating. The extent of the improvement over that of the 20th November is, therefore, the more noteworthy.

Table 2.—METHYLENE BLUE ANALYSIS.

Summary—Hand-Milking Dairies.

Inspection.	Under 1 hour.	2 hours.	3 hours.	4 hours.	5 hours.	6 hours.	7 hours.	Over 7 hours.
1st	11	8	3	3	5	1	...	...
2nd	...	...	2	1	1	1	...	19
3rd	1	1	4	2	1	6	2	4

Table 3.

Summary—Milking Machine Dairies.

Inspection.	Under 1 hour.	2 hours.	3 hours.	4 hours.	5 hours.	6 hours.	7 hours.	Over 7 hours.
1st	4	1	1	...	1	...	...	...
2nd	...	...	...	...	1	...	...	6
3rd	...	...	1 (1)	...	1 (5)	...	1 (3)	1 (1)

Tables 2 and 3 show the results of the Methylene Blue examination for hand and machine milking. The small figures (in parentheses) in Table 3 refer to the number of hours the milk from the same suppliers held the blue coloration in the first examination.

Table 4.—FERMENTATION TEST RESULTS.

Inspection.	No. of Samples.	No. of reasonable Curds.	No. of poor Curds.	Percentage reasonable Curds.
1st	17	10	17	59
2nd	22	12	10	54
3rd	24	18	6	75

Table 4 shows the bulked results of the Fermentation tests over the period. The number of reasonable curds for cheesemaking increased from 59 per cent. to 75 per cent.

The results of the competition have been most encouraging and demonstrate forcibly the effect of offering a premium for quality production and also the beneficial effect that results from the friendly rivalry which is engendered in a competition of this nature.

However, attention must be drawn to the fact that, though the results of the competition have been so satisfactory, the quality of the milk from a number of suppliers does not reach a sufficiently high standard. This applies equally to the average quality of production throughout the South-West, and it is believed that,

with very little effort, a considerable improvement can be effected. The crux of the whole problem is the provision of ample boiling water in the dairy for the scalding of all utensils after washing and again prior to use, together with efficient cooling of the milk after it is drawn. General cleanliness in milking and in the premises naturally must be of a comparative standard.

As would be expected, the leading men in this competition all believe in and practise the thorough scalding of all equipment. In fact, one whose premises and facilities could not be called good was able by attention to this factor to gain a very high place in the final results.

It is interesting to note that, while only four of the 25 competitors who completed the test use milking machines, two of these were successful in gaining first and third places. They both follow carefully the caustic soda and boiling water method of cleansing and scalding the machine as described in the Western Australian "Journal of Agriculture" for September, 1933.

The following points are mentioned as being largely responsible for success, and it is suggested that full attention be given to them so that the improvement may be continued:—

The Sterilisation of Utensils is probably the most important single factor which exerts an influence on the bacteriological content of milk. When utensils are not thoroughly washed, the resulting damage to the milk in contact with them seems obvious, but when the utensils are thoroughly washed but not scalded or sterilised, the contamination is still very serious. Reference is made to this factor in the "Journal of Agriculture," W.A., for September, 1934, pages 418-420.

Milking.—The Sediment tests revealed that considerable contamination was occurring during milking. Particles of food, dung, soil, hair, etc., could be discerned on the discs. This condition also revealed that straining in many cases was being neglected or else was very ineffective.

However, it is pleasing to note that, as time went on, a substantial improvement was recorded both in regard to the quantity of sediment and also to the type of material composing the sediment.

Many strainers, however, while they may have been effective in withholding visible dirt were responsible for considerable contamination due to their being improperly washed and sterilised. Cloth strainers are particularly liable to become a serious contaminating medium unless they are boiled and dried quickly after each milking. The use of a cotton wool disc in the strainer results in a great improvement.

The cooling of the milk immediately after it is drawn is the next most important step after the careful sterilisation of utensils and the actual operation of milking. Particularly where milk is being held over night on the farm, prompt cooling to a low temperature is necessary in order to retard the development of bacteria. The lower the temperature to which the milk is reduced, the longer will the milk keep.

Personal Factor and a Premium for Quality.—It can be recorded that the personal factor was responsible for the improvement effected. No improvement in buildings or facilities carried out during the competition could have had so great an effect. This suggests that most of the dairy farmers were not working to the limit of their knowledge but were content with producing a milk that barely reached the requirements at the factory. The response to the incentive of a prize for added effort is indicative that a premium for quality would have a still greater effect, because every man would receive the reward for the extra effort.

SELF-FEEDER FOR PIGS.

FOR QUICK AND ECONOMICAL FATTENING.

G. K. Baron-Hay,
Superintendent of Dairying.

For the feeding of a large number of pigs economically it is necessary to make use of the self-feeder, particularly where the approved system of allowing pigs an area of land on which they can graze is adopted both for fattening and for the maintenance of brood sows.

Long and convincing tests in various parts of the world indicate that the general adoption of the self-feeder is warranted, and numerous inquiries are being received by the department for a plan setting out the details for the construction of a simple self-feeder.

In utilising a self-feeder it is necessary to inspect the feeder at frequent intervals to see that the troughs are clean and that a free flow of food is available from the hopper. The feeder should be located on a dry area of land and, if possible, should be mounted on skids so that the feeder can be removed to a clean area at suitable periods.

The self-feeder illustrated is that which has given excellent results in Canada and in Australia and is suitable for feeding from 15 to 20 pigs.

Construction of Self-Feeder.

1. *The Feed Trough.*

The self-feeder rests on two 4in. x 2in. skids provided with two strong flat iron draught lugs, which render it portable.

Three 4in. x 2in. bearers are then notched over the skids. On top of these bearers the feed trough is formed, the bottom being 10in. x 1in., and the sides 5in. x 2in. on edge bolted to bearers with ⅜in. bolts through the skids and bearers. Two pieces of 8in. x 1in. wood placed at 45 degrees form the centre or back of both troughs, and two pieces of 5in. x 1in. wood placed at 45 degrees from the 5in. x 2in. side-pieces to the bottom board complete the feed trough.

2. *The Bin.*

The bin, or hopper, is constructed of wood. The frame is made of 3in. x 2in. uprights with 3in. x 1in. across the top; rafters of 2in. x 2in. and 4in. x 2in. ridge. The top is sheathed with 6in. x ⅞in. tongue and grooved boards; one side of the top acts as the door, which is composed of 6in. x ⅞in. tongue and grooved boards with two 6in. x 1in. ledges. The door and top are covered with flat iron; hinge door with three strap hinges.

The top should project well over the trough, so that water will not drip into it. The sides and end of the bin should be sheathed with 6in. x ⅞in. tongue and grooved boards. The bin is supported by 2in. x ⅜in. iron straps bolted to trough and to bin.

The slide and hinged flap are regulated with a slot and bolt and screw; the bottom of the slide is hinged with strap hinges. The slide is 8in. by 1in. wood, the flat 4in. x 1in. wood, with a strip of tin or light iron 3in. wide to cover the crack.

The whole structure measures 6 feet long by 3 feet wide, the eaves projecting 6 inches all around.

Detail of Slide and Hinged Flap.
Section
Front Elevation
Door Closed
2-2 Rafters
7/8" T&G Boarding
2-2¾" Iron Strap
Strap hinges
4-2" Skids
3'0
6'-0"
7'-0"

USEFUL BIRDS OF WESTERN AUSTRALIA.

C. F. H. Jenkins, B.A., R.A.O.U.,
Assistant Entomologist, Department Agriculture.

(*Series 1.*)

"From an economic standpoint birds represent a cash value far beyond previous belief."
—*Monthly Bulletins of Zoology, Pennsylvania Dept. of Agric., Vol. V.*

INTRODUCTION.

The man on the land has so many pests—insect, plant and animal—with which to contend that at times he is apt to forget that he is not alone in his struggle against the forces of Nature, but that Nature herself provides him with many useful allies.

Birds are amongst man's most useful friends in the ever-increasing struggle against the insect world, but they receive little credit or recompense for the work they do and are only too frequently persecuted by those from whom they should receive protection.

In the older countries of the world the importance of bird preservation is becoming more widely recognised, and strict laws provide for the protection of bird populations, but in Australia far too little importance has been given to this subject as yet, and birds have been looked upon as legitimate spoil for anyone who chooses to shoot or destroy them.

The destruction has admittedly not always been deliberate, and in many instances it follows inevitably upon agricultural expansion, but the detrimental effect of the latter may be considerably mitigated if suitable precautions are taken, and such precautions should be regarded as an economic proposition rather than the work of an aesthetic or sentimentalist, for although direct results may be difficult to demonstrate, the ultimate benefits accruing will be nevertheless certain.

In districts where extensive clearing operations have been in progress the entire native bush has often been destroyed, and with it have gone all the birds. A few patches of trees or scrub are an advantage on any holding, for shade, fire wood, posts, etc., as well as a harbour for birds, and yet how many farmers consider this aspect when clearing?

It is not enough not to wilfully destroy birds; they should be actively encouraged. Laws can be passed protecting certain species totally or at certain periods, but such laws are useless without the co-operation of the public, and until it is widely recognised that birds are not only attractive and beautiful, but also useful, this co-operation is ikely to be difficult to obtain.

It is surprising how readily people will believe the worst, not only of their fellows but of their more lowly associates on the earth. Once give a bird a bad reputation and it is never forgotten or forgiven. The crow, the eagle, the silvereye, and the emu are examples of this. Whether the reputation is warranted or otherwise (and of course sometimes it is), few people stop to think for themselves; and still fewer pause to consider the many useful forms, or the good done by the harmful species. One and all will destroy, given any pretext, but few will protect.

The introduction of foreign species is one of the most serious ways by which man may upset the balance of bird populations and is only too well illustrated in the Eastern States where the sparrow and the starling are the dominant species in the settled areas, and where native forms are being superseded.

In Western Australia little serious trouble from this source has yet been experienced, but the abundance of doves in the metropolitan area, and the rapid spread of kookaburras show what we can expect should other foreigners gain a footing.

In the ensuing series I propose to deal with some of the better known local birds and point out how they are beneficial to the agriculturist and pastoralist.

The series may include some rather doubtful characters, but the object is to show that no matter how black a reputation a bird may have, it has, at least in most cases, some compensating factors.

THE WOOD SWALLOW.

The family Artamidae which contains the wood swallows, with the exception of a single species the white-breasted wood swallow, which ranges into the East Indies, is confined to Australia.

Six species have been recorded, and all are extremely useful insect destroyers. They are moderate sized birds, rather plumply built, and although good fliers have rather broad sail-like wings quite unlike the long slender ones of the common swallow, to which the wood swallows are but remotely related in spite of their name.

Although six species occur in Western Australia, the two most frequently met with are the dusky wood swallow, *Artamus Cyanopterus* (from the Greek Artamos, a butcher; cyanos, blue; and pteron, a wing) and the black-faced wood swallow, *A. melanops* (Greek melas (melanos), black; and ops, a face).

The dusky wood swallow measures about 7 inches in length, and is a rather stoutly built bird. The general colouration is a smoky gray, the wings and tail being darker. The outer edges of several of the main flight feathers are white, and serve as a good recognition mark for this species. The tips of the tail feathers are also marked with white, giving a banded effect when the tail is spread in flight, but this feature is common to other members of the group and so is not an important field character.

This species is more or less social in its habits, and when roosting often displays a peculiar characteristic which may be likened to the swarming of bees, a large number of birds clustering together in a compact bunch.

Feeding takes place both on the ground and in the air: the birds have an easy soaring flight and may be commonly seen hawking in semi-cleared country and over open paddocks. During fallowing time they are close attendants upon the plough and eagerly snatch up any caterpillars or beetle grubs which have the misfortune to be turned up.

Examination of the stomach contents has revealed that the major portion of the wood swallows diet consists of injurious insects, such as caterpillars, grubs, beetles and grasshoppers.

In connection with the destruction of the latter pest, J. N. McGilp, R.A.O.U., writing in the "Emu" says, "From information obtained from notes and observations, there is no doubt that the wood swallows are by far the best bird agents in the destruction of the young non-flying grasshoppers. They were present over every hatching bed visited in our northern areas."*

"I am informed that in two breeding grounds these birds, assisted in their work by other birds, prevented any young grasshoppers from reaching the flying stage."

The breeding season may extend from August to December, the period varying in different districts, and with changing seasons. The nest is a cup-shaped structure made of fine twigs, dead grass and rootlets, lined with dry grass or fine roots, sometimes horse-hair. Three eggs are the customary clutch, but five are

* South Australia.

sometimes laid. They measure ¾-inch in length, and are creamy white in colour, spotted and blotched with black, brown and greyish marking, usually forming a zone round the broader end.

Both birds take part in the brooding and become quite pugnacious in the breeding season, scolding and attacking any trespasser near their domain.

Black-faced Wood Swallow (*Artamus melanops*, Gld.).

The nest is located in various places, but is seldom very high above the ground, the entrance to a broken tree spout is a favourite spot, bat tree forks or pieces of projecting bark often find favour, as do sometimes the tops of hay stooks.

The dusky wood swallow is widely distributed over Australia, but is not found in all districts. My observations locally tend to show that it is more plentiful in the lower South-Western portions of this State than elsewhere, its place inland and further North being taken by the black-faced variety.

The black-faced wood swallow is a very similar bird to the preceding species, both in habits and appearance. It is however lighter in colour, being of a light grey with a dark face. The white wing patch of the first species is also lacking, and the habit of swarming is not so commonly met with, although the birds do tend to cluster when roosting at night.

The nesting and feeding habits are similar to those already described, but the eggs are somewhat smaller and have a glossy pinkish-white ground colour, plentifully spotted with reddish-brown and dull purplish markings, usually forming a zone at the broader end.

In many parts the wood swallows are migratory, or semi-migratory birds, although a certain amount of local movement may occur, both the species mentioned are, generally speaking, resident species in the South-West.

THE PLOUGHING IN OF GREEN CROPS.

E. T. Morgan,
Officer-in-charge, Potato Branch.

Green manuring is a term that is applied to the growing and ploughing in of a crop when in full bloom. Where farmyard manure is scarce, or unprocurable, green manuring is applied as a substitute, its main object being the enrichment of the soil in humus as well as in nitrogen when a leguminous crop is selected for turning under. Green crops when ploughed under, supply a large amount of organic matter to the soil at a comparatively low cost. The land is covered by the growing crop and this, in many cases, prevents erosion and loss of nitrates in the drainage water. Leguminous crops may add as much as 150 lbs. of nitrogen per acre. In addition to this, deeply penetrating roots bring up phosphorus and potassium near the surface where the green crop decom poses on being ploughed in, so that these substances can be utilised by succeeding crops. The ploughing under of green crops makes for a great improvement in soil texture and soils are made more retentive of moisture.

As far as the supply of organic matter is concerned, almost any crop that grows in sufficient quantity and within a given time may be chosen. A great number of leguminous plants are very suitable for the purpose and there are reasons why they are preferred in many cases to non-leguminous plants. There is a species of nitrogen-fixing bacteria which attaches itself to the roots of leguminous plants, so that in addition to the supply of organic matter, these plants will serve a double purpose by also increasing the nitrogen content of the soil. However, the choice of crop to grow will depend upon the season, the amount of water likely to be available, and the length of the growing season permitting the crop to be ploughed in, before the land becomes too dry to allow of thorough decomposition. The correct time to plough in a crop is when the maximum head of green growth has been reached and before the formation of seed has commenced. Under normal conditions a crop of green stuff ploughed under at this succulent stage will decompose in from four to six weeks. Crops which are favoured by

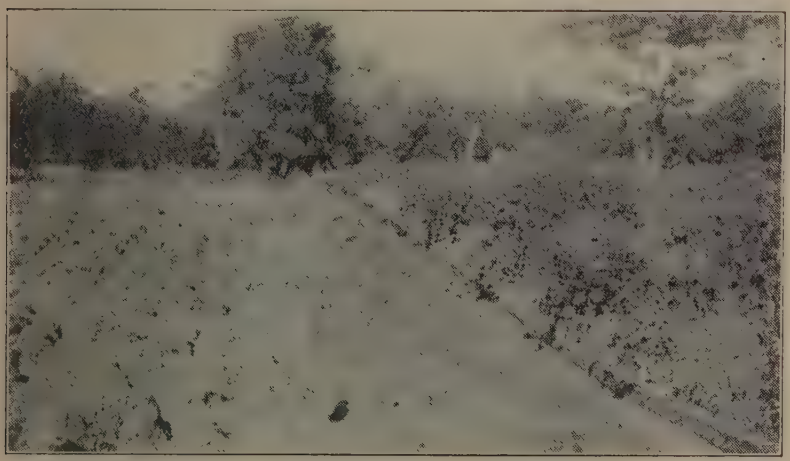
many growers are peas, tick beans, clovers, vetches, lupins, oats, rye and mustard. Mixtures of some of these plants are exceptionally good; for instance a combination of peas and oats makes a fine cover crop. Mustard is used by many of our potato growers and it is a quick growing crop which can be turned in after six weeks' growth. It has been noted, however, that this crop, as well as some others, has not grown well in many of our wetter soils in the South-West; in such places vetches and lupins are more suitable and grow well. Much may be written on the value of green manuring, but it is my intention in this article to describe the method of turning in these crops, as it is noticeable in many cases that the work of ploughing in green crops has not been very well carried out.

Generally, the majority of failures to do a good job lies in the fact that an unsuitable implement is being used. A plough for this purpose should have a good clearance between the beam and the "throat." A "goose neck" plough such as that shown in the illustration has been found very suitable for turning in all kinds of crop. Another essential is a disc or rolling coulter which, when adjusted correctly, will cut our rubbish and furrow before it is turned over. The normal cut of a disc coulter is about an inch outside the land-slide of the

Plough as set to turn-in a green crop.

plough. This coulter should be set to cut as deeply as possible, so minimising the likelihood of the plough jumping out when confronted with a thick growth. This implement must also be kept well sharpened and a touch up with a file or scythe stone occasionally will keep it in a fit condition to carry out its effective work. Another necessary assistant in the ploughing in of tall crops is a chain attached to the plough. This chain has the effect of drawing down the growth, which then allows the furrow to completely cover it. Numerous enquiries have been received asking how a chain is fixed to the plough for the effective covering of an extra heavy green crop. There are various ways of fixing the chain to the plough, but the writer has found that the best method of so doing is that as shown in the illustration. One end of the chain is fastened to the outside of the swingle bar, as shown, the other end is fastened to the beam of the plough just above the mould board, as illustrated. If two horses are used in

the plough, the end will be fastened to the outside of the double swingle bar on the right hand side. The chain should be sufficiently heavy to pull the growth down, and long enough to allow a loop to be formed, which greatly assists in pulling down rubbish. This loop of double chain thickness should be so adjusted



Crop of lupins ploughed-in at Bassendean.

that it just "lets go" before the furrow completely turns. The illustration shows a crop of lupins which were ploughed in, on sandy country, at Bassendean. The crop was about three feet high, and it will be observed that very

Crop of mustard growing as a green manure crop at Dardanup.

little of the growth was left uncovered. To the left hand side of the picture before the plough was correctly adjusted, a certain amount of growth is noticeable and as further adjustment was made, the crop was well turned under. Sandy soils are benefited to a great extent by a well ordered system of green

manuring. Such soils are naturally deficient in humus and their moisture holding capacities are low. Heavy crops of green stuff ploughed in tend to correct these defects, and the land becomes more capable of producing good crops.

The second series of illustrations show a crop of mustard at Dardanup in the growing stage and the turning-in of the crop. This crop was over six feet high and no difficulty was experienced in getting it under.

Ploughing-in the mustard crop at Dardanup.

Green manuring is a factor in the control of common scab of potatoes, and recent work in England has established that micro-organisms, found in decomposing greenstuff, fight against the scab organisms, thus lessening their attack on tubers.

Coupled with correct fertilising and cultivation, the ploughing in of green crops is a great aid in maintaining and even increasing the fertility of the soil.

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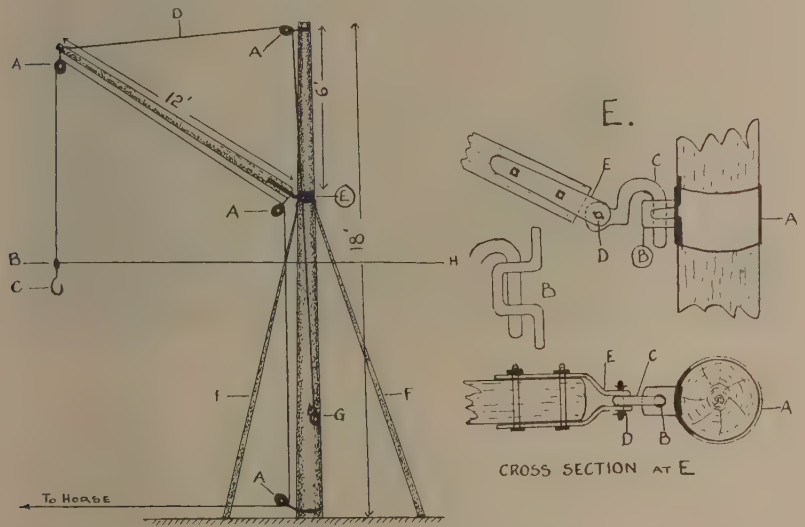
HOIST FOR LIFTING HAY OR GREEN MATERIAL.

H. G. Elliott.
Agricultural Adviser, Dairy Branch.

Owing to the numerous enquiries made for some type of hoist which can be used for raising Meadow Hay or green material on to a stack either from the ground or waggon, it was thought that the following particulars regarding the construction of a one-horse hoist would be of value.

The following illustration gives full particulars:—



Legend—"A" Pulleys; "B" Swivel; "C" Hook; "D" Rope for raising or lowering arm according to height of stack; "E" Collar and Swivel (see enlargements); "F" Stays or guy ropes; "G" Rope tie; "H" Rope to pull material over stack.
Enlargement—"A" Collar; "B" Eye (enlarged); "C" Hook; "D" Pin and Eye; "E" Straps.

Requirements:—

Poles. Upright pole 20 feet long of which 18 feet is above ground level. The pole should be at least 8 inches at the base. The arm should be at least 12 feet long and not less than 4 inches in diameter. The arm is attached to the upright pole by means of collar and swinging attachments illustrated above 12 feet from the ground level.

Pulleys. Four 4-inch pulleys attached as illustrated. A swivel and hook or grab attachment on end of hoist rope.

Collar and Swinging Attachment. A six inch collar or wound wire fitted around the pole to hold "eye" attachment. This attachment which is let into the pole is made from 14in. x 2½in. x ¾in. iron shaped as illustrated in "B" enlarged. A 1in. hole is drilled to take the hook which is made from 1in. round iron. The end of the hook is flattened and a ⅝in. hole drilled to take the pin which holds the two iron straps on the arm. The two iron straps are made of 15in. x 2½in. x ¾in. iron with holes drilled through for the pin and bolts, the iron being shaped as illustrated in cross section "E."

The accompanying photographs show a home-made hoist in action on the property of Mr. W. J. Sears, Donnybrook.

PASTURE COMPETITION—DONNYBROOK DAIRY FARMERS' ASSOCIATION.

M. Cullity,
Senior Agricultural Adviser.

The above competition was advanced a further year by inspections carried out in November, 1934, and in January and July, 1935. As explained in a previous report the final result is decided on the aggregate of inspections carried out over three years.

The scale of points used is as under:—

Permanency	30 points.
Feed Value	25 points.
Cultivation and Manuring	10 points.
Experimental Value	10 points.
Bulk	25 points.
	100 points.

An explanation of the method of judging and the arrangement of the times of inspection was given in reports in this Journal for March, 1934, and March, 1935.

The points awarded in this year's competition, together with the aggregate to date for the two years period, are as under:—

Competitor.	Permanency.	Feed Value.	Cultivation and Manuring.	Experimental Value.	Bulk.	Total, 1934–35.	Total, 1933–34.	Total, 1933–4–5.
	30	25	10	10	25	100	100	200
A. Trigwell (1) ...	24	24	8	9	23	88	84	172
C. J. Cunningham ...	26	24	8	8	19	85	83	168
A. C. Frost	23	22	7	7	18	77	81	158
R. Benson	27	19	5	2	22	75	79	154
J. Egan (1)	22	20	5	3	20	70	82	152
A. Trigwell (2) ...	24	22	5	4	16	73	77	150
R. J. Trigwell ...	20	21	5	7	18	71	74	145
B. Langridge (1) ...	19	19	7	6	18	69	71	140
J. Hearman (2) ...	19	21	6	7	17	70	69	139
J. G. Fry	17	19	6	7	13	62	68	130
J. Hearman (1) ...	12	15	6	5	10	48	59	107
H. Patroni	21	22	7	7	25	82	...	82
B. Langridge (2) ...	20	21	7	8	18	74	...	74
J. Egan (2)	15	19	5	7	11	57	...	57

A. Trigwell.

The above figures show that Mr. A. Trigwell has retained his position at the head of the list. His entry was consistently good throughout the year, although naturally the growth during the summer months was not great, but the response to the early autumn rains was excellent.

Perennial Ryegrass and Subterranean Clover. Yield 4½ tons of hay per acre. Grown by A. Trigwell, Donnybrook.

Mr. Trigwell has designed a cultural and manurial experiment to demonstrate the effect of harrowing and the application of a dressing of stable manure. Harrowing resulted in increased growth, with still better results as regards colour and vigour where the manure was applied.

Better results with manure also were obtained on the unharrowed portion. This plot consists principally of a mixture of rye grass and subterranean clover. A light seeding of Phalaris tuberosa gave a reasonable germination, and the plants are strengthening satisfactorily.

C. J. Cunningham.

The lucerne plot entered by Mr. Cunningham increased in value also, the plants being older and more vigorous. Cultivation was carried out and a demonstration designed to illustrate the effect of manuring and also the further inoculation of a portion with bacteria. At the time of the last inspection, it was too early to notice any result.

A. C. Frost.

This plot has shown a gradual improvement, particularly in respect to the strengthening of the mixture. Subterranean clover has spread while the Phalaris tuberosa, which proved somewhat disappointing in the previous year, now shows great promise.

H. Patroni.

This entry was sown too late for inclusion in the first year's judging. An excellent mixture of subterranean clover and perennial rye was inspected, which yielded 5½ tons of hay per acre. This plot was sown on a slightly raised red gum flat which had been cropped previously on a number of occasions with potatoes. No doubt the residual manure from these crops and the fact that the land was free from weeds enabled this excellent result to be obtained.

R. Benson.

This plot consisted of old paspalum flat carrying lotus major, lotus hispidus, with brome grasses and subterranean clover in the winter and spring. No alteration from the previous year can be noted. A heavy yield was obtained.

B. Langridge.

1. This plot consisted on rye grass established from seed collected from an old patch on the property. It has not improved as much as was expected, although with the increase of subterranean clover, a reasonable pasture has been obtained.

2. A further plot containing a mixture of rye grass and Phalaris tuberosa is giving greater promise, particularly with the latter grass.

J. Hearman.

These plots have not proved as successful as desired. Plot (1) was sown on very light soil with a variety of plants but has not thickened sufficiently to give a satisfactory amount of grazing.

R. J. Trigwell.

The lucerne in this plot has practically disappeared under the attacks of lucerne flea and red mite. The subterranean clover and rye grass, however, provide considerable bulk and are very useful after the early autumn rains. The Phalaris tuberosa is improving considerably.

J. Egan.

No. 1. The mixed grasses give considerable bulk and form a very useful pasture and would respond to cultivation. A light seeding of Phalaris tuberosa sown three years ago and considered wasted is now showing up to advantage.

No. 2. This plot has given comparatively little grazing but calls for comment primarily because of the excellent germination and growth of Phalaris tuberosa.

J. G. Fry.

Very little grazing has been obtained from this plot, but it deserves mention because of the way cocksfoot, rye grass, and particularly Phalaris tuberosa have persisted on a hilltop. The lucerne sown here has practically disappeared.

Many valuable lessons have been demonstrated during the term of the competition. Some may be summarised as follows:—

(a) Soil types indicate within limits the species which may be successfully grown; *e.g.,* white clover and perennial rye grass will not thrive in poor soils unless special conditions are present.

(b) The rates of sowing of perennial rye grass, Phalaris tuberosa, etc., may be considerably lower than at one time thought necessary. Quite satisfactory stands of mixed pasture have been obtained, using 5 lb. of seed of any of these species per acre on land carrying pure subterranean clover and brome grass.

(c) Where specially good results are expected with the introduced grasses, it is necessary to eliminate competition as far as possible by thorough cultivation of the seed bed after the ordinary pasture has commenced growth. A really fine firm seed bed is necessary for small grass seeds.

(d) Cultivation of the pastures results in definite improvement due to aeration of the top soil, and "root and shoot pruning." Pasture harrows are suitable implements to use in most paddocks, but occasionally more drastic treatment is advisable, particularly where a dense sod-forming grass is present, such as paspalum or kikuyu.

(e) *Manuring.*—All competitors found it necessary to use some nitrogenous fertiliser in addition to superphosphate to preserve a balance of grasses with clover, promoting their vigorous growth, and at the same time assisting to maintain soil fertility.

In the previous report for the season 1933-34, it was suggested that an application of stable manure probably would show increased growth and a better colour. This was given effect to by several competitors with definite results. The difficulty of topdressing all pasture with stable manure is appreciated, but it is hoped that the demonstrations given will bear fruit in the more general utilisation of this splendid manure, which is usually wasted. The chain harrowing of pastures is probably the best method of giving effect to this policy.

(f) Of the sown plants Phalaris tuberosa calls for special mention in view of the progressively improved results that are being obtained each year. In the first year of sowing little result was obtained, but in the second year a definite improvement was noted. In the past season this improvement was much more pronounced, and the indications are that this grass will be as valuable to the South-West as was hoped when trials with it were first instituted.

CONCLUSION.

The effect of the competition is being noted throughout the district, not only on the farms of competitors but also on those of interested friends and neighbours. This interest also is being reflected in better grazing management which incidentally is proving its worth by definitely increasing production.

DIPPING OF SHEEP.

A SEASONAL REMINDER.

Hugh McCallum,

Sheep and Wool Inspector, Department of Agriculture.

Now that the shearing season is drawing to a close, every farmer should be looking forward to the dipping of his flock. This is a matter of vital importance to the sheep industry of the State. If sheep owners do not dip their sheep in an effort to combat the destructive parasites, which are still very plentiful, much financial loss will result. In our settled districts owners of sheep should be constantly on the alert to see that they are kept clean. This can be done by frequent examinations for tick and lice.

These parasites will live anywhere, and will breed continuously on undipped sheep. Both tick and lice are frequently found on the same animal and they live by sucking the blood from their unfortunate hosts. When sheep become lice-infested they will rub themselves along a fence or against a tree until the wool is torn from the backs or sides. They bite themselves to allay the irritation caused by lice, and in doing so pluck the wool from their bodies—raw sides being noticeable in places.

When these parasites prevail we can estimate the decrease in wool and mutton values if allowed to go unchecked.

Regular dipping with proved dips is essential, and the instructions issued regarding them must be strictly carried out. The farmer should dip his sheep from four to six weeks after shearing and not delay longer. Every sheep put through the dip requires to be soaked for not less than a minute.

The value of dipping is considerable. Wool, free from tick, naturally brings higher prices than when infested; increased values are often lost through sheep neglect. In districts where farmers cannot afford a separate dip for each holding, the suggestion of installing one on the co-operative system should meet with general support. This can be erected at little cost to the interested parties.

Sheep should not be dipped during extremes of heat or cold, when thirsty, or in a heated state from driving. When ewes and sucking lambs have been dipped the lambs should be kept apart for a time.

BACILLARY WHITE DIARRHOEA OF CHICKENS.

(PULLORUM DISEASE.)

H. W. Bennetts, D.V.Sc.

Veterinary Pathologist, Department of Agriculture.

Bacillary white diarrhoea is a disease of young chickens caused by a specific germ called *Bacillus pullorum*. This germ is carried in the ovary or egg producing organ of adult hens which have contracted the disease as chickens or later in life. The germ may pass into the yolk of eggs laid by infected hens. Chickens hatched from these eggs may thus be infected with the germ at the time of hatching and usually show signs of disease before they are a week old. A very considerable mortality results. The hens which act as carriers of infection do not generally show evidence of disease although they, too, may occasionally sicken and die.

Pullorum disease is common in most countries and occurs in the Eastern States of Australia. Considering the frequent importation into this State of birds from other parts of the world it is not surprising that the disease has been introduced into Western Australia. Its presence in the metropolitan area has been determined recently but the extent of the distribution of infection is not yet known.

The purpose of this article is to inform poultry owners of its effects in the hope that they may be able to recognise any suspicious occurrence of the disease and will report it to the Department of Agriculture. It may thus be possible to control the spread of the disease and to prevent considerable economic losses from bacillary white diarrhoea. Pullorum disease "strikes at the root of the poultry industry; no one can sucessfully conduct the business if he is unable to rear a reasonable number of chickens annually."

1. *Bacillary White Diarrhoea of Chickens.*

In chickens hatched from infected eggs symptoms appear immediately after hatching or in a day or so. These birds spread infection to other chickens in the same batch which show symptoms in from 4 to 10 days later. Chickens may die suddenly. Generally, however, they huddle together, the wings are droopy, feathers ruffled and the birds appear sleepy. They have no appetite and develop diarrhoea—the droppings being white or whitish brown in colour. These adhere to the vent fluff and may paste up the opening. Deaths begin soon after hatching and may continue up to the fourth week. The death rate is high—from 40 to 90 per cent. of chickens hatched. Chicks which survive remain stunted and unthrifty for some time and may become chronic carriers—spreading infection through the eggs when they come into lay.

The disease can be diagnosed accurately only by means of laboratory tests although the early occurrence of white diarrhoea in baby chicks, associated with a high death rate, is very suggestive evidence of the presence of pullorum disease.

2. *Pullorum Disease in the Adult Hen.*

Infection of hens by the germ *Bacillus pullorum* is only rarely marked by any external evidence and it is not regarded as a common cause of death. Usually the germs are confined to the ovary or egg-producing organ; the infected developing eggs, or ova, are hard, shrunken and angular in appearance. When cut they have a tough cheesy consistency and a reddish yellow or greenish tinge—many do not develop at all and become cystic. As the ovary becomes progressively diseased the number of eggs is lessoned and fertility and hatch-ability are decreased. Finally laying may be suppressed altogether. An infected flock, obviously, is economically unprofitable.

Although pullorum infection of the adult hen generally takes on this chronic form with localization of infection in the ovary, occasional acute outbreaks of disease, with a number of deaths, have been recorded.

Strangely enough the outbreak investigated in the Perth metropolitan area was of this type. The affected hens appeared mopey and huddled up and their combs were dark. The birds had no appetite and a greenish diarrhoea was common. Deaths occurred generally within a day or so of symptoms being first noted. Some birds, however, lived for several days and became very weak and emaciated and pale in the comb. A number of these appeared to be recovering but were still carrying the infection.

On post mortem examination very definite changes were seen, particularly in the liver which was greatly enlarged and soft, generally a mottled greenish brown in colour and studded with pinhead yellowish spots. Many other organs showed evidence of disease and the ovary had the typical appearance described above.

3. *Control of the Disease.*

It should be obvious from what has gone before that treatment of the disease in chickens or hens is not indicated. An infected flock is an unprofitable one and should not be used for breeding purposes.

The eradication of the disease from affected flocks, although somewhat costly at the outset, is in the long run the only sound course. Fortunately there are proved methods of effecting this. By means of a blood test, the agglutination test, it is possible to discover which birds are carriers of the infection. It has been shown repeatedly that the carrying out of periodic testing, associated with the disposal of infected birds, and the application of aproved sanitary measures will bring about the desired results.

FIG WASP

(Blastophaga psenes).

By L. J. Newman, F.R.E.S., Government Entomologist,
and C. Sporn.

This beneficial wasp was first introduced to Western Australia from California in the year 1912, but unfortunately it failed to become established. The following year Capri figs carrying the wasp were obtained from South Australia, and several lots were introduced in succeeding years until 1919, when it was definitely proved that the wasp was established here.

This wasp is the only known medium whereby the Smyrna types of figs can be fertilised. Without the agency of this insect the Smyrna figs fail to mature a crop. The Smyrna varieties of fig trees differ from the Mediterranean or Adriatic figs with which we are so familiar in this State, in that they do not produce any crop of fruit unless crossed with the male Capri per medium of the wasp.

It may not be generally known that there are two distinct types of figs grown locally, namely those which ripen an edible fruit, without developing perfect or fertile seeds, or in other words, those varieties which become pomologically, but not botanically ripe. To this class belong all the edible varieties of figs grown in the State, with the exception of the Smyrna types. These figs which fail to produce botanically ripe fruits can only be propagated by means of cuttings, suckers or grafts. If, however, the fig wasp is introduced to these varieties, they also become botanically ripe and produce fertile seeds.

The second group of figs known as the Smyrna are unable to ripen a crop at all, except the formation of seeds takes place, when they become both pomologically and botanically ripe.

To accomplish this, fertilisation or Caprification is necessary. This has necessitated the growing of the Wild Capri, or as it is sometimes called, the male fig.

These trees were originally indigenous to Asia Minor and surrounding countries. Until the discovery was made that the Smyrna figs could only produce a crop of maturing fruit by the aid of the fig wasp, the growing of this beautiful fruit was confined to those countries where the native Capri figs grew. Once the medium of the cross fertilisation was discovered, the Smyrna fig industry was established in other countries.

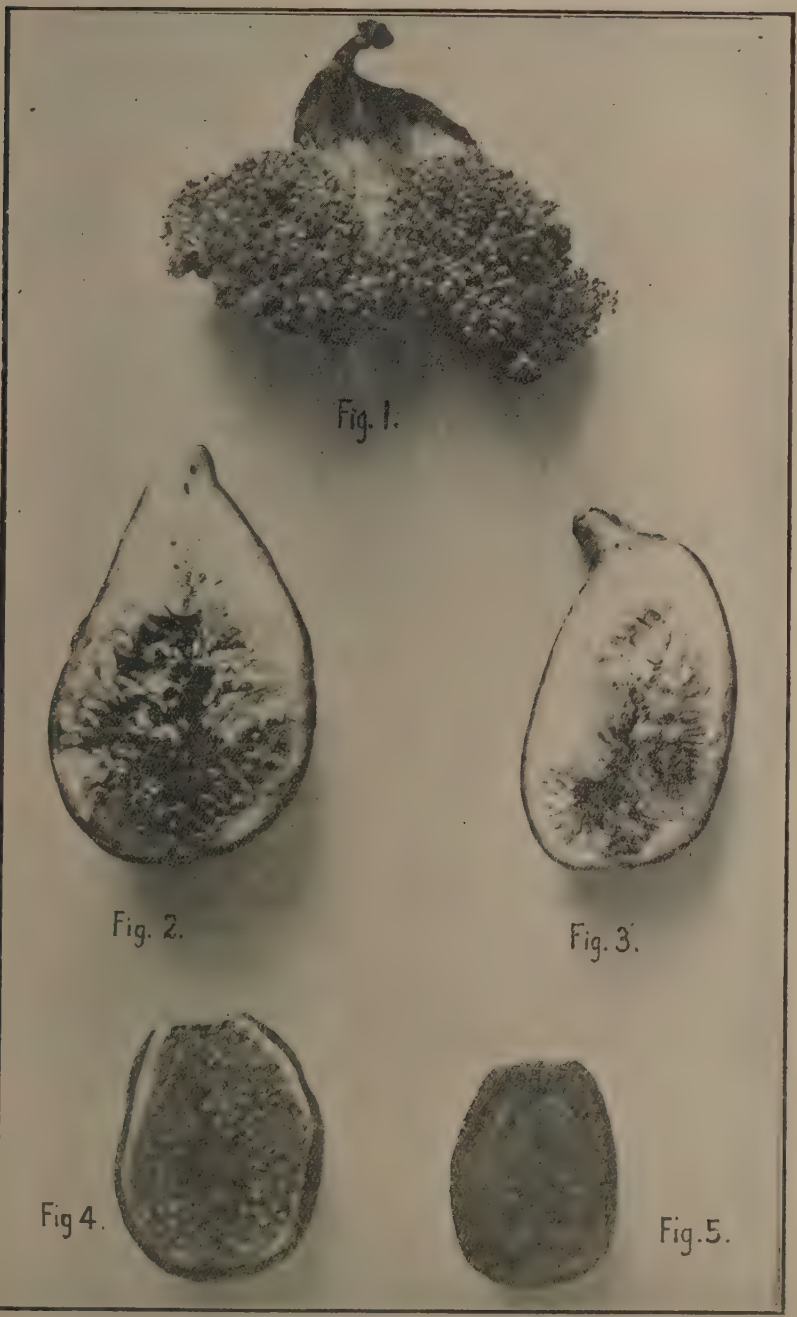


Fig. 1.—Capri fig opened showing the mass of gall flowers from which the wasps issued and the clusters of male pollen-bearing flowers.
Fig. 2.—Brown Turkey fig caprified. Note development of seeds, flesh, and size.
Fig. 3.—Brown Turkey fig uncaprified.
Fig. 4.—Brown Turkey fig caprified. Observe seed formation.
Fig. 5.—Brown Turkey fig uncaprified. Note absence of seeds.

Australia, America and other countries have introduced and also raised numerous varieties of Capri. The best known in this State are Roeding's Capri Nos. 1, 2 and 3, Robson's Special Capri from South Australia, and a local seedling named Simmon's Capri. The last named is an accidental seedling which was discovered growing in East Fremantle by the late Inspector Simmons of this Department. This tree in some districts, particularly the coastal areas, is proving the best host fruit in this State for the breeding of the fig wasp.

Capri trees produce a non-edible fruit, containing male and gall flowers. The fig wasp enters these fruits and there lays its eggs in the gall flowers. Tiny legless larvae hatch form the eggs, which live and feed all their pre-adult life, within the gall flowers. When mature the female wasps by the aid of the wingless males, emerge from the galls and leave the figs by way of the opening in the top of the fig. In this act of leaving the fig, the female wasps have to force their way through a forest of male flowers, which are situated inside at the top of the fig. Once outside the host fruits, the wasps immediately fly around seeking fresh capri fruits into which to lay. The male wasp which is apterous or wingless, never leaves the fruit.

If it happens that the pollen-laden wasp enters a Smyrna or other variety of fig, the pollen grains which are on her body are shed in her efforts to find gall flowers and thus cross fertilisation is accomplished. To assist in this act of cross fertilisation, the Capri figs are picked between the 15th to the 20th of December and placed either in small open receptacles made of wire netting, which are suspended in the Smyrna trees, or the figs are gathered and tied on to strings and hung in the trees. The Smyrna figs are in a receptive state from the time they are three-eighths of an inch to one inch in diameter, but after a certain limit of size and time without fertilisation, they turn yellow and fall.

One of the difficulties encountered in the work of establishing the fig wasp has been to secure a continuity of Capri fruits to fit in with the various issues of the wasp and thus ensure a good carry-over of wasp-infested Capri fruits during the winter and early spring.

In a study of this wasp under local conditions, it has been found that there are four generations during the year. These issue approximately between the following dates:—15th to 20th December, which is the generation used for the fertilising of the Smyrna crop, the 1st to the 5th February, the 15th to the 20th March and the 15th to 20th of September.

In a number of pruning experiments undertaken in the fig orchard owned by Mr. C. Sporn, it was found that by pinching back the strong lateral growths of Roeding's Capri No. 3 to two buds, say two laterals a day, between the 24th October and the 7th November, an extra crop of Capri figs is produced. These figs will furnish suitable host fruits for the wasps which issue between the 15th and 20th December and will issue a further crop of wasps between the 1st and 8th February. These wasp-carrying Capri fruits should be gathered and placed in Roeding's No. 1 Capri trees, which at this time will have a crop of fruits, in a receptive stage of growth.

If this crop is set by the aid of the wasp it will hang on the trees throughout the autumn and winter and thus constitute an additional carry-over crop to that set in March, which is often very light, owing to the poor supply of wasps at that time of the year.

It was found also beneficial to pinch back the laterals on the Roeding's Capri No. 1 or any other varieties of Capri between the 15th and 25th of December. This act will hasten the growth of the Capri figs and thus ensure a greater supply of fruits in readiness for the issue of wasps in the first week of February.

If this crop can be induced, a great weakness in the life cycle of the wasp, under local conditions, can be largely overcome, namely the usually poor crop of Capri in February resulting in a much lessened winter carry-over.

Growers are advised to make every effort to grow Simmon's Capri, and, when once certain that this tree will carry a succession of fruits in their district, they can dispense with the pinching back of Capri No. 3.

When ordering Capri trees, stipulate that they must be Nos. 1 and 3 Roedings and Simmon's Capri. No. 1 is a strong growing tree, and yields a large crop of figs during mid-December, just when wanted for use to fertilise the Smyrna figs. No. 3 Roeding's Capri is less vigorous, but responds readily to the pinching back of the laterals between 24th October and 7th November.

It is well with the aid of manure to keep the stock Capri trees in good healthy growing condition as upon the supply of wasp-carrying Capri fruits, depends entirely the setting of the Smyrna crop. It is best to plant the Capri trees together in an area where they can be kept under observation.

The grower will then be better able to judge when the Capri fruits are ready for distribution amongst the Smyrna fruits or other Capri. By having the trees handy a closer watch can be kept on the winter carry-over crop to see that the fruits are not knocked off by parrots or other pests.

The Smyrna fig grows readily under our climatic and soil conditions and the dry summer period is wonderfully adapted to the natural drying of fruit and will produce a fine quality of Smyrna fruit. As a fresh fruit there is no fig grown that has a better flavour and would prove most popular with the consuming public.

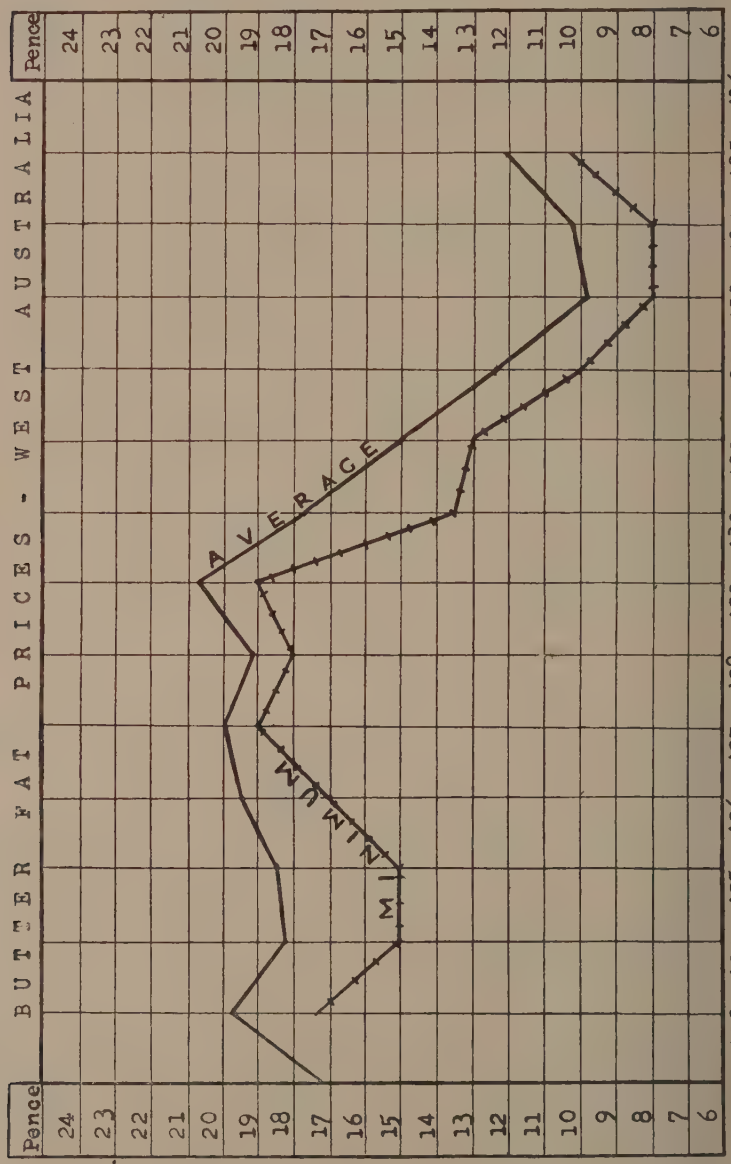
GRADE HERD RECORDING—YEAR ENDING 31st MAY, 1935.

G. K. Baron-Hay,
Superintendent of Dairying.

Interest in Grade Herd Recording has not only been maintained amongst those farmers whose herds are being tested but, owing to the results that have been obtained during the second year of testing, applications are being received from farmers in new districts, who are desirous of forming Herd Recording Units One new Unit was inaugurated at Forest Grove, and it is hoped that in the near future five more will be inaugurated in the South-West portion of the State, totalling 14 Grade Herd Recording Units.

It is pleasing to record that during the year the price for butter fat has shown a definite tendency to rise. A glance at the graph showing the average prices ruling for butter fat during the last 13 years shows this clearly, and also indicates the necessity for increasing the average production of dairy cows in order to meet the low prices ruling since 1931. It will be seen that the price of butter fat fell as low as 8d. per lb. during 1933 and a portion of 1934, but has averaged 12d. per lb. during the current year. It is anticipated that this price may be maintained for several seasons in view of the legislation which has been passed for an Australian price of 140/- per cwt. or 1/3 per lb. for butter.

This period of a fixed price of not less than 1/- per lb. for butter fat, however, should not be regarded as a permanent minimum, but should rather be regarded as a period during which dairy farmers have an opportunity of placing their house in order so as to meet further periods of low prices which may occur in the future.



The aim of the Grade Herd Recording Scheme is to provide a means of assisting farmers in this direction, and it was hoped that within two years from the inception of the Scheme the average production of all cows under test would exceed 200lb. butter fat, at which production it is believed dairy farmers can meet all their commitments.

In compiling the record of results for the first year, 1933-34, it was necessary to refer to published information regarding Herd Recording in other States, in order to show what might be expected of the Scheme. Two years' results, however, are now available and although, as is mentioned later, the whole of the improved yields cannot fairly be ascribed to Herd Recording alone, the Scheme undoubtedly has exercised a considerable influence.

Table 1 below shows clearly the increased production from tested cows over the years 1933-34 and 1934-35.

Table 1.—AVERAGE PRODUCTION OF COWS.

Year.	No. of Cows.	Milk.	Average Test.	Butter-fat.
		gals.	%	lbs.
1933–34	4,038	415	4·35	180·6
1934–35	4,088	456	4·56	207·8

It will be seen from Table 1 that approximately the same number of cows were tested during the two years, while the average production of butter fat per cow increased from 181 to 208 lb. or 27lb. per cow. This increased production at the ruling rate for butter fat has been worth 27/- per cow, while the cost incurred by the farmer has been 2/6 per cow. Farming would be a profitable venture indeed if all investments return a similar profit!

As in the previous year, however, the various units differ considerably in their average production as will be shown by reference to Table 2.

Table 2.—AVERAGE PRODUCTION OF COWS IN EACH UNIT.*

Unit.	No. of Herds.	No. of Cows.	Milk.	Test.	Butter-fat.	
					1934–35.	1933–34.
			lbs.	%	lbs.	lbs.
A.—Donnybrook	22	401	5,163	5·10	266·8	219·5
B.—Serpentine	19	518	4,681	4·12	193·1	172·2
C.—Cookernup	21	507	4,348	4·22	183·5	160·4
D.—Harvey	20	453	4,511	4·74	205·9	186·4
E.—Brunswick	19	615	4,549	4·53	206·0	169·2
F.—Dardanup	14	453	4,053	4·74	192·2	188·6
G.—Capel	12	716	4,788	4·31	203·1	182·9
H.—Balingup	15	324	4,363	4·86	212·4	174·6

* Does not include cows under test for less than three months.

Illustration 1.—Mr. J. Parkin's herd, Dardanup, grazing in June on early-sown oats. These 16 Grade Jersey Cows averaged 306 lbs. of butter fat per cow.

The farmers in the Donnybrook Unit are to be congratulated on increasing the production of their cows from 219 lb. to 267 lb.—an increase of 48 lb. per cow.

It is interesting to record that, although the average production of cows in this unit was reasonably high during the first year of testing, culling was practised more severely by members in this unit than in any other, partly due to the fact that this district is an old established one where the farms are well developed and the herds are as large as the farmer desires to carry.

Table 2 is definitely encouraging to those units where the average productions are low. It will be noted that these units have increased their production during the two years by about the same amount per cow as other units, and it is confidently expected that all units will exceed 200 lb. butter fat per cow during the coming year. It also is hoped that the general average will be at least 215 lb. per cow. It would be unreasonable to claim the credit of this all-round general improvement to Grade Herd Recording alone, as a number of factors are concerned with this increased production.

The reports of Grade Herd Recorders and advices received from members of units, however, show very clearly that, in addition to supplying information regarding the production of cows, Grade Herd Recording has become a focal point around which all farming operations revolve. The farmer uses the records to note the results of any change in feed; he is impressed with the necessity for fodder conservation, and any care or attention lavished on his milking cows is well repaid by increased yields.

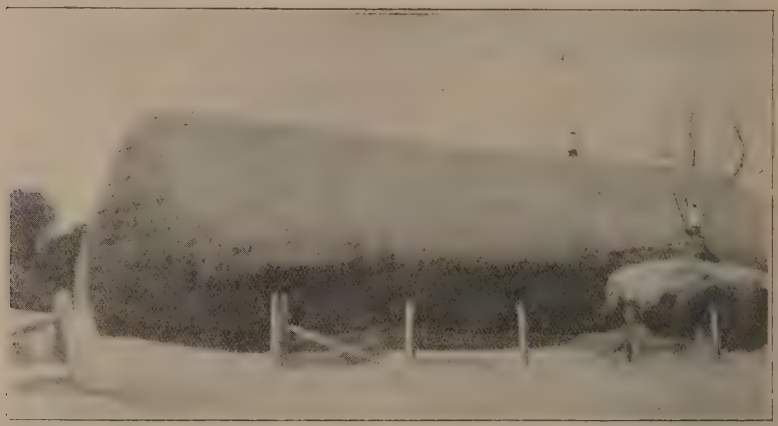


Illustration 2.—Stack containing 150 tons meadow hay on Elgin estate of Dr. J. S. Joel. The manager, Mr. Busquet, has increased production per cow by 54 lbs. in one year, by ample feeding and "culling."

The question of the utilisation of the information given each month by the recorder is one that calls for a thorough knowledge of each individual cow in the herd before the elimination of the unfit can be intelligently commenced. It would be unreasonable to aim at such a high figure for production in the early stages of herd recording as to require the elimination of the majority of cows in the herd. A different standard, therefore, would be adopted by each farmer, depending on the quality of the cows he may own. Obviously farmers endeavouring to improve the average production of 267 lb. butter fat per cow, as in the Donnybrook Unit, may be eliminating cows which would be a distinct advantage in herds where the

average production is only 183 lb. per cow. As a matter of fact farmers from Harvey and Brunswick Units have purchased tested cows from the Donnybrook area, and, as each cow is tattooed in the right ear for identification, farmers are purchasing these cows with a certain degree of assurance regarding production.

Table 3, showing the production of the three leading herds compared with that of the three lowest producing herds in each unit illustrates this point clearly:—

Table 3.—PRODUCTION OF THE LEADING THREE HERDS IN EACH UNIT COMPARED WITH THE LOWEST THREE HERDS.

Unit.		No. of Cows.	Milk per Cow.	Average Test.	Butter-fat per Cow.
			lbs.	%	lbs.
Donnybrook	1	58	6,134	5·43	334·4
	2	59	4,068	4·93	187·4
Serpentine	1	69	5,660	4·50	254·8
	2	110	3,562	4·07	145·2
Cookernup	1	67	4,946	4·68	231·5
	2	53	3,515	3·98	139·9
Harvey	1	71	6,527	4·16	272·3
	2	85	3,170	4·47	138·1
Brunswick	1	80	5,339	4·60	245·4
	2	72	3,323	4·71	156·6
Dardanup	1	51	5,103	4·95	252·9
	2	57	3,150	4·80	151·8
Capel	1	40	6,006	4·24	251·7
	2	71	4,178	4·28	160·6
Balingup	1	70	5,484	4·90	269·1
	2	76	3,831	4·75	182·2

1—Average 3 High-Producing Herds. 2—Average 3 Low-Producing Herds.

The following results, which have been obtained in representative individual herds during the last year, will show what has been effected and that, by the intelligent use of the information supplied by the herd recorder, many low producing herds can be rapidly raised into the profitable category.

Illustration 3.—Mr. S. F. Russell's herd, Serpentine, grazing on paspalum and white clover irrigated pasture. Average production per cow for 31 cows was 257.1 lbs. butter fat.

TABLE 4.—HIGHEST PRODUCING COW IN EACH UNIT.

DONNYBROOK UNIT.

Cup presented by Boyanup Dairy Co.

			Milk.	Average Test.	Butter-fat.
			gals.	%	lbs.
R. J. Trigwell	"Buttercup," J. ...		1,072	5·50	596·0
				1933–34	(577·6)

SERPENTINE UNIT.

Cup presented by Serpentine Co-op. Cheese and Butter Factory, Ltd.

			Milk.	Average Test.	Butter-fat.
			gals.	%	lbs.
S. F. Russell	"Nancy," Gr. A. ...		986	4·74	467·6
				1933–34	(442·0)

COOKERNUP DISTRICT.

Cup presented by Hon. Hobart Tuckey, M.L.C.

			Milk.	Average Test.	Butter-fat.
			gals.	%	lbs.
C. M. Corker	"Judy," Gr. J. ...		723	5·36	396·7
				1933–34	(405·4)

BRUNSWICK UNIT.

Cup presented by Browne's, Ltd.

			Milk.	Average Test.	Butter-fat.
			gals.	%	lbs.
H. Piggott	"Brindle" Gr. S.H. ...		1,094	4·39	480·5
				1933–34	(371)

DARDANUP UNIT.

Cup presented by Hon. Leslie Craig, M.L.C.

			Milk.	Average Test.	Butter-fat.
			gals.	%	lbs.
J. Parkin	"Fanny," Gr. J. ...		719	6·04	440·6
				1933–34	(442)

CAPEL UNIT.

"Summerlea" Cup presented by Messrs. Dunkley Bros.

			Milk.	Average Test.	Butter-fat.
			gals.	%	lbs.
T. Jameison	"Betty," S.H. x J. x F.		1,200	4·09	492·7
				1933–34	(381·2)

BALINGUP UNIT.

Cup presented by Manjimup Dairy Produce Company, Ltd.

			Milk.	Average Test.	Butter-fat.
			gals.	%	lbs.
S. C. Maidment	"Jennie," Gr. J. ...		960	4·87	467·8
				1933–34	(413·1)

A. = Ayrshire; J. = Jersey; F. = Freisian; S.H. = Shorthorn; Gr. = Grade.

With a view to stimulating interest in production, a number of trophies have been presented to be held by the owner of the highest producing cow in each unit. The following rules have been adopted in the competition for these Cups:—

1. The Trophy shall be held for 1 year by the owner of the cow producing the greatest quantity of butter fat and completing her lactation period during the testing year.

2. Such cow to be eligible for the Competition shall be at least 5 months pregnant at the end of the lactation period.

3. A replica of the Cup will be given to the winner each year and will be held permanently by him.

4. The Competition will be conducted for 5 years, the farmer obtaining the greatest number of successes during this period becoming the permanent owner of the Trophy.

   In the event of a different farmer winning each year, the owner of the highest producing cow will retain the Trophy.

Table 4 shows the winners for 1934-35, and, for comparison, the production of the winning cow the previous year is shown in brackets.

It will be noticed that in general the tendency is for the production of these leading cows to rise, indicating that the Competition is stimulating interest in the care and attention of stock, which it was hoped would be the case.

Illustration 4.—A healthy bunch of heifers reared from cows in the "top herd" in Brunswick Unit, owned by Mr. H. Piggott, whose 45 cows averaged 258 lbs. butter fat.

When culling a herd it also is desirable to have definite information regarding what reasonably may be expected from any herd of a known production, and the percentage of herds with reasonably high and profitable production records. This has a definite bearing on the possibility of replacing any culled cows by individuals of higher capacity. This information is given in Table 5.

TABLE 5.—HERDS GROUPED ACCORDING TO PRODUCTION.

Herds Tested less than 273 days omitted.

Unit.	No. of Herds.	Pounds of Butter-fat per Head.				
		300–350.	250–300.	200–250.	150–200.	100–150.
Donnybrook	22	4	12	4	2	...
Serpentine	19	...	2	7	8	2
Cookernup	21	...	...	4	15	2
Harvey	20	...	4	8	6	2
Brunswick	19	...	1	12	5	1
Dardanup	14	1	...	4	9	...
Capel	12	...	1	4	7	...
Balingup	15	...	2	6	7	...
Totals	142	5	22	49	59	7
Per cent., 1934–35		3·5	15·5	34·5	41·5	5·0
Per cent., 1933–34		1·3	3·9	20·3	53·6	20·9

The comparison of the production of herds in the two years—shown at the foot of Table 5—is a very clear indication of the definite trend for the elimination of unprofitable cows and the raising of herds to a remunerative level. During the first year approximately one-fifth of the herds tested yielded less than 150 lb. butter fat per cow. During the second year only one-twentieth were in this category. Herds in the 150-200 lb. group had likewise been reduced by about 10 per cent. Herds which are just profitable had been increased from 20 per cent. to 34 per cent., while the definitely profitable herds producing over 250 lb. butter fat had been increased five-fold. If, for no other reason than this, it is believed these results would justify grade herd recording.

Definite evidence is not lacking that farmers are utilising the results provided by the scheme for the elimination of unprofitable cows, as is clearly shown in Table 6 below in which all cows under test have been classified according to their production. It will be noted in the two lines at the bottom of the table the great increase in the number of cows producing over 200 lb. butter fat in 1935, namely, 49 per cent. as against only 37 per cent. the previous year.

TABLE 6.—COWS IN EACH UNIT GROUPED ACCORDING TO PRODUCTION.

Unit.	No. of Cows.	Average Butter-fat Production per Cow.						
		Over 500 lbs.	400–500 lbs.	300–400 lbs.	200–300 lbs.	150–200 lbs.	100–150 lbs.	Culled.
Donnybrook	477	3	15	116	194	45	28	76
Serpentine	518	...	8	34	193	135	123	25
Cookenup	459	...	...	13	144	163	100	39
Harvey	501	...	7	43	153	132	112	54
Brunswick	615	...	2	52	268	154	102	37
Dandanup	453	...	2	20	151	169	93	18
Capel	696	...	3	83	235	169	183	23
Balingup	324	...	6	34	145	64	60	15
Totals ...	4,043	3	43	395	1,483	1,031	801	287
Percentage 1934–35		0·1	1·1	9·8	36·7	25·5	19·8	7·0
Percentage 1934–34		0·05	0·45	4·15	30·19	29·54	26·42	9·20

Still further progress in the elimination of the unprofitable producers is expected during the 1935-36 season. In some herds it has been possible to considerably increase production by varying the system of management. One factor which has a definite bearing on the average production of cows in a herd is that of "date of calving." An analysis of all cows tested during 1933-34, taking into account the month in which these tested cows commenced their lactation, proved that there was a considerable advantage as far as production was concerned by commencing the lactation period early in autumn, preferably early in May.

Where cows calved after September and were called upon to produce milk on dry pasture feed supplemented with meadow hay and no green material, there was a handicap of as much as 80 per cent. against these cows.

In view of this it is interesting to note the percentage of cows in each Unit, which completed a full 9 months' testing period and, therefore, must have calved not later than August, 1934. This is shown in Table 7.

TABLE 7.—PERCENTAGE OF COWS COMPLETING 273 DAYS RECORD IN EACH UNIT.

	Per cent.	Average Butter-fat Production. lbs.
Brunswick	81	206·0
Donnybrook	77	266·8
Serpentine	52	193·1
Balingup	46	212·4
Harvey	41	205·6
Cookernup	40	183·5
Capel	17	203·1
Dardanup	10	192·2

Illustration 5.—Maize and cow peas on Mr. J. Parkin's property, Dardanup. Ample summer fodder assisted cows in this herd to average 306 lbs. butter fat.

It will be noted in Table 7 that the percentage of cows completing a lactation period during the twelve months varies considerably, the only two districts which may be said to show satisfactory figures in this connection being the Brunswick and the Donnybrook districts.

Extremely low percentages of cows completing the 9 months' milking period were found in the Capel and Dardanup Units. The following observations made by the Herd Recorder, Mr. R. R. Rutherford, at Capel, will in part explain this, but it still appears desirable that cows should commence lactation periods earlier in this district.

Mr Rutherford writes:—"The Capel Unit may be divided into three groups of farms according to the type of country:—

1. Those farms which embrace both coastal country carrying summer pasture and an area of inland plain country suitable for growing winter fodders.

   It is interesting to note that the leading three herds in this Unit owned by Messrs. T. Jamieson, C. A. McCormack and G. Payne, all belong to this group.

2. Farms comprising coastal land alone.

   There is a necessity for the feeding of phosphatic lick on this type of farm, and a tendency for commencing lactation periods late in autumn owing to summer grazing being available.

3. Farms composed of inland plain country only.

   In order to obtain the best results on this type of land, *lactation periods should commence early in autumn,* as it is noticeable that there is an average reduction of 25 per cent. in yield during December each year. This is partly due to the general lack of fodder conservation, but a number of farmers have signified their intention of increasing the area reserved for silage and hay during the coming season."

The low percentage of cows completing the lactation period of 9 months in the Dardanup Unit, namely 10 per cent., also calls for comment. It is significant in this Unit that those herds which contain the highest percentage of cows commencing lactation early in autumn were also the highest producers. For example, the Herd Recorder, Mr. A. P. Devlin, states that "there was a general tendency in the Ferguson district for increased fodder conservation, particularly silage, and an endeavour to commence lactations early in autumn. The herd owned by Mr. J. Parkin which obtained the highest average production in the Unit, namely, 305.6 lb. butter fat for 16 cows, contained no less than 11 cows or 62 per cent. which had completed their 9 months' lactation period by March. This necessitated cows calving not later than June. No less than 10 herds in this Unit did not contain a single cow which completed the 9 months' lactation period during the year."

On unirrigated farms, therefore, it is essential for the lactation period to commence early in autumn, and this in turn necessitates the provision of either meadow hay or silage for feeding to cows until such time as winter grazing is available.

The farmers in the Balingup Herd Recording Unit are to be congratulated on the average increase in the production of butter fat of cows in the Unit from 175 lb. to 212 lb. per cow. This is in part due to the culling of a number of very low producing cows, but also due to improved methods of herd management. Mr. Tindale, the Herd Recorder for this Unit, reports that considerably increased quantities of fodder were conserved by members. The average amount was 1.4 tons of hay and 1 ton of silage per cow, which is an increase of .7 of a ton of fodder calculated as hay over the amount conserved in 1934.

Illustration 6.—A well made stack of clover silage on Mr. G. C. Melville's property, Wonnerup. On unirrigated farms, surplus "clover" should be conserved as silage for summer feeding.

It is interesting to note that the quantity of fodder conserved by Mr. A. Tomerini, the owner of the leading herd, is approximately double this amount and equal to that expressed as the aim in the Better Dairying Competition. Mr. Tomerini conserved 2.17 tons of silage and 1 ton of meadow hay per cow, and, in addition, his herd of 23 Jersey cows was fed 40 tons of maize during the dry months. This herd produced the excellent average of 286.5lb. fat per cow and was followed closely by that of Mr. S. C. Maidment with 273.3lb. for each of his 22 cows. Mr. Maidment also is a keen advocate of fodder conservation.

Rule 6 governing the operation of Grade Herd Recording in this State requires that, within five years from the inception of the Scheme, the bulls owned by members of the association shall all be pure bred bulls and, if possible, ex tested dams.

Table 9 setting out the percentage of pure bred bulls in each Unit shows that members are fully aware of the advantages accruing to the use of pure bred bulls, and of particular interest is the comparison between the percentage in 1934 and that of a year later in 1935. In 1934 the percentage of pure bred bulls was 69.7 per cent., while in 1935 the percentage had risen to 84.2 per cent. The percentage increase was mainly in the Jersey and Illawarra Shorthorn breeds as shown in Table 9.

Table 9.—PERCENTAGE OF PURE BRED BULLS IN EACH UNIT ACCORDING TO BREED.

Unit.	No. of Herds.	Per cent. P.B. Bulls.	Percentage of Total Pure Bred Bulls.					
			Jersey.	Guernsey.	A.I.S.	Friesian.	Ayrshire	Red Poll.
Donnybrook	22	91·1	80·0	5·0	15·0	...	...	...
Serpentine	19	73·7	14·3	7·1	35·7	35·8	7·1	...
Cookernup	21	89·0	11·7	23·5	53·0	5·9	...	5·9
Harvey	23	73·9	47·0	11·8	29·4	5·9	5·9	...
Brunswick	22	81·8	38·9	5·5	55·6	...	...	...
Dardanup	21	76·2	68·7	6·3	12·4	6·3	...	6·3
Capel	12	93·7	40·0	...	36·7	6·7	16·6	...
Balingup	16	94·1	81·1	6·3	12·6	...	...	...
Total Percentage, 1934–35 ...	...	84·2	47·7	8·2	31·3	7·6	3·7	1·5
Total Percentage, 1933–34 ...	...	69·7	52·2	2·6	31·3	7·9	4·3	1·7

The comparative rarity of grade cows producing 300 lb. of butter fat is well shown in Table 10 below. Of 3,766 cows tested for over 3 months, only approximately 12 per cent. exceeded this figure, while only 1 per cent. produced over 400 lb. butter fat.

It will be seen that the majority of the cows tested come within the group producing 150 lb. to 300 lb. butter fat. Therefore, the most economical means of increasing average production is by eliminating cows in the lowest group and by gradually endeavouring to increase the number of cows in the higher groups. It is obvious from the large number of cows producing from 200 to 300 lb. butter fat that, in the average herd at present, it would be unwise to eliminate cows of this class.

It will be realised from these figures the very severe standard which is set under the Pure Breeds Herd Recording Rules before a mature cow is issued a Production Certificate. This standard is no less than 350 lb. butter fat in 9 months and is only attained by 1 grade cow in 12. This is one of the reasons why the surest method of increasing average production is by the use of pure bred bulls ex cows to which Production Certificates have been awarded.

Table 10.—COWS GROUPED ACCORDING TO AGE AND PRODUCTION.

All Cows in Milk less than 100 days not included.

Age Class.*	Groups according to Butter-fat Production.						
	Over 500 lbs.	400–500 lbs.	300–400 lbs.	200–300 lbs.	150–200 lbs.	100–150 lbs.	Total Cows.
Mature	3	39	355	1,078	515	277	2,257
Three years	...	2	30	244	237	188	721
Senior 2 years	1	4	76	110	89	280	
Junior 2 years	1	6	85	159	267	518	
Totals	3	43	395	1,483	1,021	821	3,766

* Age at commencement of Lactation.

Following the practice adopted since the inception of the scheme, results have been published each month and also quarterly during the testing year, supplying information regarding the individual production of each herd in the Unit. The herds are identified by numerals only except in the case of the leading three herds

in which instance the name of the owner is supplied. The production of the leading three herds in each Unit is, therefore, shown in Table 11 below, and for comparison the productions of the herds occupying the same position in the Unit during the previous year. It will be noted that in every instance there is a considerable increase in these leading herds; in particular, the production of the herd owned by Mr. H. Noon, Donnybrook, deserves special mention.

Illustration 7.—Grade Herd Recording might have saved this cow. The daughter of this grade Guernsey cow, owned by Mr. H. Eddy, Forest Grove, produced 470 lbs. of butter fat. The dam, shown above, was butchered before testing because of her heavy appearance.

Table 11.—LEADING THREE HERDS IN EACH UNIT.

Unit.	No. of Cows.	Bull.	Milk.	Test.	Fat.	Owner.
A.—Donnybrook ...	19	J.	6,927	5·35	371	H. Noon
	19	J.	6,083	5·43	331	L. C. Field
	20	J.	5,393	5·60	302	H. Bradshaw
B.—Serpentine ...	31	G.	5,787	4·44	257·1	S. F. Russell
	19	Gr. A.I.S.	6,227	4·12	256·9	D. L. Jones
	19	J.	4,832	5·12	249	E. M. Rose
C.—Cookernup ...	25	J.	4,849	4·87	236	C. M. Corker
	24	A.I.S.	5,415	4·26	231	J. A. Baron-Hay
	18	G.	4,547	4·92	224	A. R. Testar
D.—Harvey	28	Gr. J.	6,107	4·45	281	Mrs. Blackburn
	24	A.I.S.	6,976	3·99	279	Hanks & Sons
	19	F.	6,498	4·03	257	F. Byrd
E.—Brunswick	45	J.	5,631	4·58	258	H. Piggott
	12	Gr. A.I.S.	5,502	4·35	239	R. Cruickshank
	23	J.	4,884	4·88	238	S. Bowers
F.—Dardanup ...	16	Gr. J.	6,048	5·05	306	J. Parkin
	17	Gr. J.	4,269	5·34	228	Mrs. C. Richards
	18	Gr. J.	4,993	4·50	225	J. M. Gardiner
G.—Capel	21	A.I.S.	6,812	3·97	270	T. Jamieson
	45	J.	5,185	4·70	243	C. A. McCormack
	53	Ayr.	6,021	4·06	242	G. Payne
H.—Balingup	23	J.	5,140	5·57	286	A. Tomerini
	22	A.I.S.	5,965	4·58	273	S. C. Maidment
	25	J.	5,350	4·62	247	H. Scarr

Mr. P. T. Wyllie, the Herd Recorder for the Donnybrook Unit, reports that "the owners of the leading four herds, namely, Messrs. H. Noon, L. C. Field, H. Bradshaw and C. Cunningham, whose herds all average over 300 lb. butter fat per cow, have consistently fed some concentrate, generally bran, to the higher producing cows according to their monthly production. All these farmers have a number of small fields and practise rotational grazing In addition, the cows in these Units were rugged during the cold wet months, and Mr. Noon specially considers that this practice contributed in no small degree to his fine average of 371 lb. butter fat per cow."

It will be seen from these remarks that high production entails a considerable degree of skill in management in addition to the capacity of cows to return the fodder consumed as a marketable dairy product in the form of milk or butter fat.

Tables 12 to 18 set out in detail a record of the productions of each herd tested during the year 1934-35.

Table 12.—DONNYBROOK (UNIT "A")—Herd Recorder: P. T. Wyllie.

Owner.	No. of Cows.	Average Milk per Cow.	Average Test.	Butter Fat per Cow.
		lb.	%	lb.
H. Noon	19	6,927	5·35	370·69
L. C. Field	19	6,083	5·43	330·51
H. Bradshaw	20	5,393	5·60	301·97
Herd "H"	17	5,578	5·38	300·48
" "T"	21	5,953	5·00	299·98
" "E"	15	5,992	5·00	299·64
" "A"	33	5,977	5·00	299·18
" "C"	16	5,209	5·33	277·80
" "L"	20	4,975	5·46	272·07
" "A 1"	10	5,212	5·19	270·69
" "K"	19	5,010	5·34	267·55
" "Z"	26	5,323	5·00	266·50
" "N"	10	5,095	5·20	265·55
" "D"	21	5,494	4·78	262·76
" "X"	13	5,080	5·00	258·32
" "P"	19	5,129	4·95	254·24
" "R"	14	4,683	5·08	238·05
" "I"	11	4,532	5·22	236·82
" "W"	9	4,261	5·50	234·43
" "Q"	23	4,805	4·34	208·46
" "F"	20	3,772	5·16	194·95
" "M"	16	3,116	5·09	158·88

Table 13.—SERPENTINE (UNIT "B")—Herd Recorder: A. R. Powell.

S. F. Russell	31	5,787·5	4·44	257·10
D. L. Jones	19	6,227·5	4·12	256·94
E. M. Rose	19	4,832·0	5·12	249·21
Herd "S"	23	6,404·1	3·61	231·17
" "B"	28	5,440·6	4·19	228·07
" "I"	28	5,593·1	3·98	222·62
" "T"	34	5,869·2	3·68	216·04
" "L"	25	5,037·4	4·26	214·50
" "Q"	31	5,124·1	3·96	202·98
" "O"	26	4,545·8	4·21	191·34
" "W"	42	4,251·2	4·43	188·73
" "E"	10	3,960·3	4·43	175·73
" "C"	13	3,875·1	4·19	162·66
" "P"	43	3,928·9	4·07	160·01
" "U"	16	4,191·8	3·81	159·67
" "V"	20	3,965·2	3·96	157·14
" "R"	19	3,925·5	3·96	155·49
" "N"	10	3,306·0	4·33	143·30
" "A"	81	3,508·7	4·07	143·01

Illustration 8.—Ample reserves of clover hay on Mr. J. Parkin's farm, Dardanup. There is no need for purchased concentrates where clover is cut as soon as seeding commences.

Illustration 9.—Grade Jersey "Fanny of Lands End," owned by J. Parkin, Dardanup. Produced 440 lbs. butter fat in 9 months.

Table 14.—COOKERNUP (UNIT "C")—Herd Recorder: E. Ker.

Owner.	No. of Cows.	Average Milk per Cow.	Average Test.	Butter Fat per Cow.
		lb.	%	lb.
C. M. Corker	25	4,875·0	4·87	236·08
J. A. Baron-Hay	24	5,415·6	4·26	230·70
A. R. Lester	18	4,546·7	4·92	223·69
Herd "Q"	28	4,929·3	4·06	200·13
" "A"	15	4,639·8	4·30	199·51
" "T"	22	4,890·5	4·05	198·06
" "B"	28	4,794·5	4·08	195·61
" "3C"	16	3,951·2	4·87	191·42
" "7C"	19	4,403·6	4·30	198·35
" "P"	27	4,469·8	4·18	186·84
" "M"	22	4,205·3	4·44	186·71
" "F"	41	4,489·6	4·07	182·73
" "6C"	33	4,133·6	4·35	179·81
" "N"	9	4,430·5	3·90	172·79
" "S"	59	4,136·5	4·11	170·01
" "1C"	25	4,080·2	4·09	166·88
" "H"	11	3,616·2	4·49	162·37
" "J"	32	4,789·7	3·34	159·97
" "W"	22	3,779·7	4·18	157·99
" "X"	21	3,895·9	3·83	149·21
" "2C"	10	2,870·0	3·93	112·79

Table 15.—HARVEY (UNIT "D")—Recorder: J. Morgan.

Mrs. A. Blackburn	28	6,107·5	4·45	281·04
R. Hanks & Sons	24	6,975·9	3·99	278·62
F. Byrd	19	6,498·2	4·03	257·20
Herd "N"	24	5,109·8	4·99	251·27
" "C"	19	4,390·0	5·01	231·13
" "E"	17	4,937·4	4·8	231·07
" "G"	28	4,768·5	4·8	229·00
" "O"	28	4,730·6	4·89	226·77
" "R"	17	5,387·9	4·01	219·75
" "D"	14	4,236·1	4·30	218·64
" "L"	21	4,964·2	4·19	207·22
" "F"	22	4,319·3	4·68	200·36
" "AC"*	8	3,387·2	5·95	198·09
" "B"†	9	4,393·05	4·50	195·84
" "P"	28	3,926·7	4·20	165·92
" "J"	12	3,844·3	4·28	164·41
" "I"	23	3,246·5	4·10	158·76
" "A"	27	3,147·3	4·61	158·69
" "AB"	14	3,495·7	4·60	157·07
" "K"	16	3,001·4	5·20	154·31
" "W"	22	3,771·8	3·83	140·02
" "V"	47	2,736·3	4·39	119·90
" "AD"‡	10	1,875·0	4·68	86·12

* Six tests only. † Seven tests only. ‡ Four tests only.

TABLE 16.—BRUNSWICK (UNIT "E")—HERD RECORDER: S. A. HARDY.

Owner.	No. of Cows.	Average Milk per Cow. lb.	Average Test. %	Butter Fat per Cow. lb.
H. Piggott	45	5,631	4·58	258·16
R. Cruickshank	12	5,502	4·35	239·51
S. Bowers	23	4,884	4·88	238·41
Herd "W"	25	4,769	4·94	235·76
" "O"	42	5,732	4·26	235·66
" "P"	56	4,186	5·16	216·18
" "B"	39	5,214	4·14	215·88
" "E 1"	29	4,187	5·06	212·14
" "A"	24	5,018	4·23	212·12
" "H"	21	5,034	4·18	210·53
" "C"	38	4,858	4·32	209·95
" "V"	46	4,777	4·30	206·03
" "X"	28	4,437	4·56	202·56
" "L"	27	4,178	4·46	186·41
" "U"	53	3,797	4·76	180·83
" "R"	25	4,170	4·15	172·94
" "Q"	28	3,563	4·83	171·97
" "J"	31	3,871	4·23	163·80*
" "D"	19	3,117	5·11	159·32
" "S"	39	3,434	4·07	140·93*
" "E"	35	3,290	4·21	138·51

* Tested for 7 months only.

TABLE 16.—DARDANUP (UNIT "F")—HERD RECORDER: A. P. DEVLIN.

J. Parkin	16	6,048	5·05	305·64
Mrs. C. Richards	17	6,269	5·34	228·00
J. M. Gardiner	18	4,993	4·50	224·99
Herd "R"	17	4,809	4·60	221·23
" "4"	12	4,612	4·50	207·69
" "K"	26	4,986	4·03	200·97
" "Z"	33	4,489	4·40	198·66
" "W"	12	4,220	4·68	197·89
" "A"	50	3,722	5·31	197·66
" "N"	24	3,946	4·90	194·90
" "J"	17	4,088	4·70	192·45
" "U"	9	3,713	5·10	190·80
" "5"	16	3,599	4·87	175·35
" "M"	30	4,134	4·23	175·24
" "3"	23	3,582	4·90	174·73
" "Q"	14	3,422	5·00	170·90
" "6"	25	3,143	5·15	161·86
" "T"	37	3,894	4·12	160·76
" "S"	15	3,286	4·60	154·23
" "8"	15	3,079	4·90	151·12
" "7"	27	3,087	4·86	150·05

TABLE 17.—CAPEL (UNIT "G")—HERD RECORDER: R. R. RUTHERFORD.

T. Jamieson	21	6,812·3	3·97	270·32
C. A. McCormack	45	5,184·6	4·70	242·74
G. Payne	53	6,021·1	4·06	241·88
Herd "M"	29	5,616·9	4·15	232·45
" "N"	35	5,358·97	3·74	201·58
" "H"	63	4,704·1	4·13	199·82
" "J"	48	4,127·5	4·64	194·66
" "I"	98	4,014·4	4·78	189·73
" "A"	71	4,079·8	4·75	181·93
" "L"	148	4,075·0	4·61	177·32
" "C"	39	3,781·7	4·11	154·04
" "E"	26	3,676·7	4·11	150·31

Table 18.—BALINGUP (UNIT "H")—Herd Recorder: A. M. Tindale.

Owner.	No. of Cows.	Average Milk per Cow.	Average Test.	Butter Fat per Cow.
		lb.	%	lb.
A. Tomerini	23	5,140·5	5·57	286·53
S. C. Maidment	22	5,962·5	4·58	273·34
H. Scarr	25	5,350·4	4·62	247·39
Herd "N"	23	4,761·8	5·19	247·33
" "R"	8	4,992·0	4·74	236·96
" "T"	22	4,605·6	5·01	231·15
" "Q"	9	4,589·3	4·88	223·42
" "P"	19	4,584·4	4·77	218·76
" "H 3"	18	3,743·8	5·30	198·66
" "H 1"	22	3,880·0	5·01	194·52
" "A"	8	4,273·6	4·49	192·14
" "F"	34	3,777·0	4·98	188·21
" "C"	35	3,817·5	4·92	188·18
" "H 2"	20	4,089·9	4·47	183·11
" "M"	21	3,586·2	4·88	175·19
" "O"	9	2,647·6	4·30	113·97*

* Tested for six months only.

Illustration 10.—"Jenny" H.S. 20, owned by S. C. Maidment, Balingup. Production 467.8 lbs. butter fat in 9 months.

BETTER DAIRYING COMPETITION.

Addendum.—"Journal of Agriculture," June, 1935, page 124, Table 4. The following points should be inserted in the column for Quantity of Fodder Conserved per Cow:—

S. C. Maidment, 130; A. Tomerini, 92; T. Giblett, 120; H. E. Kendal, 130; G. E. White, 65; F. O. Nelson, 105; T. W. Stevenson, 80.

WEEDICIDES.

STRENGTHS OF APPLICATION.

G. R. W. Meadly, B.Sc., Botanical Branch.

Enquiries are frequently received with regard to the concentrations of various chemicals when used for the destruction of weeds, and this article serves to summarise information concerning the more commonly used weedicides.

Owing to the expense of both material and labour, chemical sprays for the eradication of weeds are not generally recommended. Under certain circumstances, however, where cultural methods are not practicable, they serve a useful purpose. Sprays are used mainly for the control of such vigorous perennial weeds as Canada Thistle (*Cirsium arvense*) and Skeleton Weed (*Chondrilla juncea*) which have underground stems capable of producing new plants from small severed sections. Cultivation under these circumstances, unless repeated very frequently, would merely serve to spread the weed. Again, railway tracks are frequently cleared of plant growth by means of a chemical spray applied from a moving locomotive. Gravel paths and tennis courts are often difficult to keep free from weeds and as the disturbing of the surface, particularly in the case of a gravel tennis court, is not desirable, the use of a spray is very convenient. Such selective weedicides as arsenic pentoxide and sulphate of ammonia may be employed for the destruction of annual clovers and other weeds in lawns.

In the following section information is given concerning the more commonly used chemical weed-killers.

Sodium chlorate.—Sodium chlorate is probably the most successful weedicide in use at the present time. A 2½ per cent. solution (i.e., 1 lb. to four gallons of water) is sufficiently strong to kill comparatively weak annual weeds such as chickweed (*Stellaria media*) and nightshade (*Solanum nigrum*). For general purposes a 10 per cent. solution (1 lb. to 1 gallon of water) is recommended, while in exceptional cases, such as when dealing with Blackberries (*Rubus fruticosus*), a 15 per cent. solution can be used at times with advantage. Improved results have been obtained by adding glue to sodium chlorate prior to application. Experiments carried out recently at the Wagga Experimental Farm indicated that the maximum destructive results with Skeleton Weed (*Chondrilla juncea*) were secured by the application of a 10 per cent. solution, containing two ounces of glue per gallon at the rate of 150-200 gallons per acre. Acidification of the spray by the addition of ¼ teaspoonful of sulphuric acid per gallon is reported by Sampson and Parker to increase the efficiency of sodium chlorate spray used against St. John's Wort (*Hypericum perforatum*) (1).

Full particulars regarding method of application, dangerous properties, etc., are contained in Leaflet 330 (2) of this Department.

Calcium chlorate.—This is available usually as a proprietary line mixed with calcium chloride, such as "Weedex." The chloride content absorbs moisture from the atmosphere and thus considerably reduces the fire risk compared with sodium chlorate. Under local conditions, pound for pound, sodium chlorate has proved more effective than commercial calcium chlorate, but by increasing the concentration of the latter in order to make the chlorate contents comparable,

the calcium compound has given encouraging results. Concentrations recommended according to the type of weed range from 5 per cent. to 30 per cent. (½ to 3 lbs. per gallon). As with sodium chlorate, the solution should be applied to the foliage in the form of a fine spray, according to instructions contained in leaflet 330 (2).

Sodium arsenite.—White arsenic, arseneous oxide, is not readily soluble in water, but when boiled along with equivalent quantities of washing soda or caustic soda, soluble sodium arsenite is formed. This substance is not inflammable, but is dangerously poisonous to all classes of animals. Details concerning the preparation of this substance and methods of application are contained in Leaflet No. 442 (3).

A solution made up from 1 pound white arsenic, 1 pound washing soda and thirty gallons of water, is suitable for killing weak growing weeds such as chickweed (*Stellaria media*), while a 1-1-4 solution is suitable for strong growing perennial weeds such as Nut Grass (*Cyperus rotundus*). Improved results are reported by adding sulphuric acid in order to produce the acidity necessary for penetration (1). Just prior to use, the addition of 5 per cent. by weight of concentrated sulphuric acid is recommended. Sodium arsenite is usually used on gravel paths and hard tennis courts where there is no chance of stock gaining access to the poison. The 1-1-4 solution along with ½ lb. of whiting for marking purposes is also used for pouring into the frills of green timber which has been frill ringbarked. This hastens the killing action of the ringing and also reduces suckering.

Ammonia sulphate.—Sulphate of ammonia assumes a dual purpose as it may be used both as a weedicide and a fertiliser. Many annual clovers such as Hop Clover (*Trifolium procumbens*), Suckling Clover (*T. dubium*) and Woolly Clover (*T. tomentosum*) invade our lawns and provide a laborious task if they are to be hand weeded. The application of a 2½ per cent. (¼ lb. to 1 gallon) solution of ammonium sulphate does much to reduce the clover content of a lawn, at the same time acting as a tonic to the grass. The solution may be applied by means of a watering can at the rate of about 1 gallon per eight square yards. The addition of one part of calcined sulphate of iron to every three parts of ammonian sulphate will improve the weed-killing properties and also produce a darker green colouration in the grass. There is an alternative dry mixture consisting of three parts of ammonium sulphate, one part of calcined iron sulphate and twenty parts of sand, used at the rate of four ounces per square yard. The number of applications depends on the weediness of the lawn, but the treatment should be continued at approximately fortnightly intervals (4). Watering or rain is not desirable after application.

Taprooted weeds such as Flat Weed (*Hypochoeris spp.*) may be eradicated by means of a mixture made up as follows:—

7 parts sulphate of ammonia,
3 parts calcined sulphate of iron,
10 parts of sand.

A pinch of this should be applied to the crowns of the weeds during fine weather. A second application after an interval of about ten days will generally result in the death of the weeds.

Arsenic pentoxide.—This substance has been used with considerable success as a selective weedicide on lawns, bowling greens, putting greens, etc., in New Zealand (5) and has also given satisfactory results under local conditions. The lawn should be mown prior to treatment and the foliage should be quite dry so that dilution of the solution does not occur. For general purposes a 1-80 solution, i.e., 1 lb. of arsenic pentoxide to eight gallons of water, should be used, but for badly weed-infested lawns under wet conditions a 1-60 solution gives best results and is quite safe.

The required quantity of arsenic pentoxide should be dissolved in about 1 gallon of cold water and then diluted to the required strength. The solution should be applied in the form of a fine spray at the rate of about 240 gallons per acre. Plants killed by this treatment include Winter Grass (*Poa annua*), Flat Weed (*Hypochoeris spp.*), and the troublesome annual clovers. Arsenic pentoxide is poisonous and if the hands are wetted unduly during spraying operations, harmful burning occurs in the quick of the finger nails.

Sulphuric acid.—Sulphuric acid is used to an appreciable extent in Europe for the eradication of weeds, particularly Cruciferous weeds such as Charlock (*Brassica sinapistrum*) in crops. Spraying is done when the weed is in the seedling stage, a 5 per cent. solution being the usual strength applied at the rate of 100-200 gallons per acre. Experiments carried out in Arizona (6) showed that under the existing conditions a 5 per cent. solution killed most farm weeds including Dodder (*Cuscuta spp.*), but several applications of a 10-15 per cent. solution were required to kill Johnson Grass (*Sorghum halepense*) and Nut Grass (*Cyperus sp.*). The acid does not readily adhere to the vertical leaves of cereals and has little effect on them apart from a temporary browning.

The commercial concentrated acid may also be used for killing Flat Weeds (*Hypochoeris spp.*) in lawns. A few drops from a pipette dropped into the heart of each weed is sufficient.

Sulphuric acid must be handled with extreme care owing to its damaging action on the skin and clothes as well as the corrosion of most metals, particularly when dilute.

Iron sulphate.—This is also used in Western Europe for the destruction of broad leaved plants, particularly Charlock and Wild Mustard in cereal crops. The usual recommendation is a 20 per cent. solution applied at the rate of 50 gallons per acre when the weed seedling is in the four-leaf stage.

Copper sulphate.—This is used for the same purpose as iron sulphate, but is somewhat more expensive. Fifty gallons per acre of a three per cent. solution is the usual application.

Common salt.—Common salt should only be used under exceptional circumstances owing to the lasting detrimental effect on the soil. It is suitable for gravel paths, tennis courts and other places where no vegetation is desired. One to two pounds per square foot or twenty to thirty tons per acre applied in a dry state is the average requirement.

There are various other preparations undergoing trial, but not in general use, such as ethylene dioxide, ammonium sulphocyanate and certain chromates. Those listed above, however, are the chemical weedicides most in use at the present time.

LITERATURE CITED.

1. *A. Morgan*:
   1934—"Hoary Cress Control," Journal of the Department of Agriculture, Victoria, Vol. XXXII., Part 1, pp. 1-6.

2. *G. R. W. Meadly*:
   1934—"Chemical Weed Killers—the Chlorates of Sodium and Calcium," Journal of the Department of Agriculture, W.A., Vol. X., No. 4, pp. 481-487.

3. *G. R. W. Meadly*:
   1934—"Sodium Arsenite as a Weedicide," Journal of the Department of Agriculture, W.A., Vol. XI., No. 3, pp. 521-523.

4. *R. B. Dawson and T. W. Evans*:
   1931—"The Establishment, Maintenance and Renovation of Lawns," Journal of Ministry of Agriculture, London, pp. 711-718.

5. *E. Bruce Levy and E. A. Madden*:
   1931—"Weeds in Lawns and Greens," New Zealand Journal of Agriculture, June 20th, 1931, pp. 406-421.

6. *J. G. Brown and R. B. Streets*:
   1928—"Sulphuric Acid Spray: A Practical Means for the Control of Weeds," University of Arizona Bulletin, No. 128.

COMMON AILMENTS OF POULTRY AND THEIR TREATMENT.

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It is intended in the following to describe the more common ailments to which poultry are at times subject, and to explain methods of treatment quite within the powers of the average poultry farmer. At the same time it should be remembered that it is a bad policy to wait until disease is present, and every effort should be made to prevent the onset of those diseases which can reasonably be anticipated. For instance, vertigo, colds, catarah, roup in all its forms, bronchitis and pneumonia should always be expected during changeable weather, when a heat wave is followed by a cool change, and strong efforts should be made towards their prevention rather than allow them to develop.

A sick fowl always consumes a vast amount of water, necessitated by excessive body temperatures, and a good general preventive measure is therefore to keep ailing fowls from contaminating the drinking water used by birds in good health. Hence a water trough three (3) feet above the level of the floor on the ledge containing the nests is recommended as only a bird in good health can reach it and any sick bird will usually be found beneath it looking up to where the water is located. It is thus easily noticed and can be doctored early in the progress of its particular ailment.

Aspergillosis.

This very common disease frequently causes heavy losses in poultry and other species of birds when kept in confinement. It is due to a mould, *aspergillus fumigatus*, which is found in grain and straw, especially when they are damp. Unfortunately, the disease is not quickly recognised by the poultry farmer, as the losses

are not of epidemic form but are more or less spread over a long period. One or two fowls die every now and then. In adult birds there is a wasting away. The appetite diminishes and thirst increases. It is a common disease with chickens and at times causes very heavy losses. Bad housing and bad feeding weaken the stock so much that they have little resistance to the disease. In young chickens aspergillosis usually appears in the form of pneumonia.

On post mortem examination, whitish or yellowish-green patches of false membranes are found on the mucous lining of the windpipe bronchial tubes. At times, these lesions are found in the mouth, gullet, crop, and intestines. These nodules are about the size of a pin's head.

Remedy.—There is no certain remedy. The spores are very resistant. The most effective remedy is fumigation, and to prevent this trouble feed good food, house properly with correct ventilation, and do not allow any dampness in the litter.

Bumblefoot.—This is a bacterial infection setting up an inflammation of the tendons of the foot, producing a more or less hard and painful swelling and causing lameness. It may take the form of a corn. This can be easily withdrawn, but in most cases the web of the foot swells. The abscess contains pus surrounded by a capsule. In poultry pus is seldom liquid, generally taking the form of a hard cheesy mass.

When the abscess is noticed, treat with iodine until it becomes ripe, *i.e.*, shows a distinct head, under which is seen the yellowish mass. It should then be opened with a clean knife. The cheesy matter should be cleaned out and the wound painted with iodine or perchloride of iron. Always try to open the abscess on the upper side of the foot as this is an easier position to keep clean. Any wounding of the base of the foot generally results in Bumblefoot. Too high perching and alighting heavily on concrete or other hard floors is a frequent cause of the trouble.

Bronchitis.

Symptoms.—Rapid breathing and a wheezy noise when held close to the ear. The comb and wattle often turn a bluish colour. This colour is due to insufficient oxygen owing to laboured breathing. The causes are exposure, damp quarters, stuffy housing, and overcrowding.

Should the birds have an epidemic of bronchitis, look to the cause and eliminate it. Individual treatment is laborious, so flock treatment should be resorted to. Give one teaspoonful of aconite to each 60 birds daily in the water or milk which mixes the wet mash; continue until trouble abates. Twelve (12) drops of spirits of turpentine in a teaspoonful of olive oil has been found helpful. If it is desired to apply aconite individually the dose is one (1) drop to a teaspoonful of water daily.

Apoplexy—Vertigo.

Vertigo may be caused by hereditary influence, overfeeding, excessive heat or great excitement. It is common with birds kept in confinement. Birds throw the head forward in a tremulous manner and then falter in gait. They are helpless in an advanced stage. Often birds are found dead in the nest, and during heat waves it is advisable to take away the trapnests for that period, and at the same time frequently clear the nests.

Remedy the defects and keep the bird in the shade; administer a 4-grain dose of sodium bromide every second day. Plenty of Epsom salts should be placed in the water. During heat waves dampen the scratching litter before the heat is at its maximum. Over-fat birds are very susceptible to heat and generally succumb.

Bacillary White Diarrhoea—Pullorum Diseases.

This disaster disease of newly hatched chickens is caused by an infection of Bacillus pullorum. The mortality is very high. The chicks are attacked immediately they are hatched and the mortality is highest during the first three to four days, and continues to occur up to the tenth day. The symptoms are moping, huddling together and pasting up of the vent with whitish excreta, loss of appetite and ruffled feathers.

Although chicks may show these symptoms they may not have pullorum disease, but some other illness. Nevertheless, whenever chicks show these troubles and die up to the tenth day, one should not hesitate to bring the dead and dying into this department in order that a blood test may be taken to ascertain the true cause of death.

The infection is introduced into the egg from a chronic infection of the ovary of the hen before the egg is laid, or in the healthy hatched through the soiling of the food or water by the droppings of infected hens or by an infected incubator or brooder house.

Any young chickens which survive the onslaught are carriers. They often retain the bacillus in their system and in later life the ovaries are infected and so the vicious cycle is completed.

Many infected eggs do not hatch and the practice of feeding incubator-clear eggs to young chickens is a further source of infection. Do not under any circumstances feed incubator clears to any stock; rather bury them deeply.

Custom hatching is a definite source of infection. A diseased egg may hatch out a chick and that chick mingling with clean chicks passes on the disease. This may quite easily spread throughout the country and cause untold damage to young stock, not only then but in later years.

Rarely do adult fowls die of the infection but the infected adult fowl is continually spreading the disease. This disease shows up in chickens in the form of white pasted excreta which mats down the fluff near the vents. The chicken has a miserable appearance and it often cries out with pain when trying to void. When acute, the chicken is prostrated and dies in a very short time.

The period of incubation is three to ten days and those with the disease show its infection three to four days after hatching. Bacillary White Diarrhoea resembles aspergillosis or coccidiosis, both of which show a white diarrhoea, but whereas B.W.D. shows mortality within three or four days, deaths due to the other two are only shown at a later date.

There is no known cure. Isolation of each batch on new clean ground away from other stock may help; but as infection may be spread by the carrying of the germ on the boots of the attendant, it will be recognised that the chances of overcoming the trouble are slight.

Scrupulous cleanliness must be observed. If after four days no infection is noticed one can assume that the chances of infection are then very slight.

Whenever a batch of chickens recover from infection of B.W.D., they can with benefit be given a tonic of 40 grams of citrate of iron and quinine to each gallon of drinking water.

In order to eliminate the carriers from the flock it is essential that every breeding bird should be submitted to a blood test and all positive reactors eliminated from the breeding pen. This should be a continuous practice, as some birds, while being negative at the first test, may respond to a second test six weeks later.

One should definitely regard this disease as the worst ailment we have affecting young chickens and every endeavour should be made to eliminate the carrier from the flock.

Coccidiosis.—This is one of the worst diseases with which the industry has to cope, especially in chicks. If coccidia are present in young stock, mortality will reach as high as 70 per cent. or 80 per cent. The disease spreads rapidly, and those surviving birds receive such a set-back that they can never be profitable. Hence the advice to "kill off" all which are affected or are in contact with diseased stock.

Coccidiosis is due to a parasite (*Ermeria commodium*). The droppings of affected fowls contain enormous quantities of "cocysts" as the parasite is known at this stage. It is here very resistant to disinfectants and can live in subsoil for 12 months or more. The cocyst resembles a miniature egg which in moisture and warmth "hatches" or sporulates into four smaller elements or primary infective germs. This period takes at least 48 hours, and it is during this time that disinfectant measures which are described below are most effective.

This phase of the disease is the important basis of control. The unsporulated cocyst if swallowed will not produce coccidiosis, and the severity of the disease is due entirely to the number of primary infective germs present and consumed due to contamination of feed, water and soil. These infective germs are swallowed by the bird, journey to the intestines, are broken down by the intestinal juices which set free other elements which attack the walls of the intestines, grow and multiply and destroy these walls. Other forms now appear with further divisions and finally a fertilised female "the cocyst" is passed out in the droppings. So much for a rough idea of the life cycle of the germ which causes coccidiosis. Unfortunately little can be done to check the ravages inside the chicken. We must concentrate on outside influences to cope with the trouble. The disease is encountered in chickens of all ages, but is more pronounced after three weeks to ten weeks of age.

Symptoms.—Suspect coccidiosis when diarrhoea begins to make its appearance and do not delay in obtaining expert advice. A microscopical examination is necessary to confirm any suspicion of the presence of coccidia. Acute diarrhoea with or without blood in the droppings, thirst, wasting away, and the chicks appearing listless and unthrifty. On post mortem examination the caeca or blind gut is usually enlarged and may or may not contain blood-stained material. On the appearance of diarrhoea with presence of blood in chicks over a fortnight old, suspect coccidiosis.

Control.—By sanitation and by internal treatments.

Sanitation.—Remove the droppings daily and burn. Heat will kill the cocysts. The use of lime on the floors helps in keeping the birds from being contaminated by their droppings. Keep shifting the birds to new ground if the houses have no floors with which to control the trouble. Sunlight is a control. Ground once infested should not be used for a period of twelve months.

Treatment.—Kerr's treatment given below is of great importance and has been found the most effective:—

Make a solution of iodine crystals, 1 part by weight, potassium iodine, 2 parts, water 50 parts. To a quart of fresh or separated milk add 3ozs. of the above iodine solution, and heat in any vessel until it becomes white. This is the stock solution and one pint should be added to every gallon of the drinking water used.

This method of treatment in conjunction with the use of the flame of a painter's blow-lamp on the brooder and on the brooder house floors has an immediate effect on the death rate. B.W.D. is an abbreviation of the words Bacillary White Diarrhoea, known as Pullorum disease, quite a separate disease from coccidiosis.

Crop Bound.

Long fibrous grass will cause crop binding. The birds are listless, having a hard heavy crop. The fibres have most likely balled and clog the outlet (oesophagus). It may also be caused by overeating after a period of starvation. Treat as soon as possible. There are two methods; one is to pour lukewarm water down the throat and then knead the crop. Suspend the fowl head downwards and try to force the contents out. Be careful not to choke the bird. The surest remedy is to pluck the feathers from the top of the crop, make a small incision and remove the contents of the crop. Then clean out with warm water and pour in a little olive oil. Using a needle and cotton, draw the incision together. Keep the bird quiet for 24 hours. The first feed should be soft, after which the bird can be placed on an ordinary diet.

Remove the cause and save a repetition of the trouble. It is very prevalent when chaff is substituted for green feed.

Depluming Mite.

Depluming mite or itch mite is another cause of loss. This mite is very small and cannot be seen by the naked eye. It saps the feather at its root and evidence of its presence is noted when fowls show a bareness at the abdomen, accompanied by a reddish skin generally called "sunburn" by the beginner. Depluming mite can go right through a flock of birds and besides being a cause of feather eating, is unsightly and an irritant. Clean it out by rubbing over the affected parts any vegetable or animal oil; this will immediately effect a cure.

Enteritis. (Inflammation of the intestines.)

The symptoms of this are a white diarrhoea and, in some cases, signs of blood, intense thirst and prostration. Enteritis does not come without some cause and it is best to find the cause of the trouble. It may be bad foods, salts, poisons or internal diseases.

Apart from internal disorders, the main cause in Western Australia has been due to the practice of dusting the sheds and yards with lime. Lime is a very good disinfectant but it can be abused. When dusting with lime take care that it is well slaked and dust it through a piece of hessian or any similar material which will not allow little lumps to pass. Having dusted, see that the residue is so disposed that the fowls do not have access to the lumps remaining. These lumps may be unslaked lime and as the fowls consume them (they will pick out and consume anything of a lumpy nature), these lumps then slake inside the crop and cause an intense inflammation. When lime causes the trouble, it is well nigh incurable. Olive oil administered may ease the pain and is worth trying. Two (2) teaspoonsful of sodium sulphocarbolate in one pint of milk and given to the bird liberally will help.

To be continued.

METEOROLOGICAL INFORMATION.

Stations.	Temperature.				Rainfall.		Temperature.				Rainfall.		Temperature.				Rainfall.	
	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.
	Mean.	Highest.	Mean	Lowest.			Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.		
	SEPTEMBER, 1935.						OCTOBER, 1935.						NOVEMBER, 1935.					
					inches.	inches.					inches.	inches.					inches.	inches.
Chapman State Farm	68·9	77·5	44·4	37·9	1·11	1·61	75·3	87·6	48·4	37·5	0·59	0·97	80·6	103·8	54·3	46·3	0·01	0·31
Geraldton	67·9	73·0	52·2	43 5	0·84	1·35	71·7	87·8	52 9	42 8	0·64	0 73	74·9	100 2	64 1	48·5	0·03	0·24
Waleboing	64·9	74·1	42 1	34·5	1·88	2·14	72·5	84·2	44 4	32·3	0·46	1·26	82·7	100·3	50 2	41·1	0 03	0·53
Perth	64·3	67·8	50·5	41·6	3 41	3·44	68·3	81·0	50 6	42·4	2 20	2·22	73·5	92·5	56 1	48·9	0 24	0 77
Katamunda	61·6	68·0	47·8	41·5	4·91	4·66	66·5	78·5	48·4	40 2	2·94	3·13	73·0	91·5	53·5	47·2	0·33	0·97
Bunbury	62·2	65·0	49·5	38·7	2·90	3·64	66·1	78·0	47 8	39 0	1·88	2 40	69 6	82·8	51·9	41·8	0·28	0·97
Bridgetown	63·1	70·5	41·7	3 25	4·20	3·98	69·4	82 0	41 3	30 5	4·11	2 98	77·1	97·0	44·5	35·0	0 34	1·11
Albany	63·0	72·5	47·6	3·65	4·46	4·19	63·5	75·2	48·9	40 5	2·87	3 25	67·3	75·2	51·7	44·6	1 16	1·44
Merredin State Farm	67·2	77·8	41·3	3·15	0·67	0·87	73·6	87 7	47·0	32·5	1·40	0 83	84·7	103·6	53·9	43·8	0·04	0·41
Northam	66·8	76·0	43·7	3·64	1·11	1·60	73·2	85·8	46·1	25 8	0 91	1 03	87·4	104·0	53·6	41 4	*nil*	0 38
York	66·3	76·7	42·8	35 0	1·13	1·60	71·8	84·2	44 6	34 0	0 91	1 08	81 6	100·0	51·9	40 0	0·04	0·42
Narrogin State Farm	65 5	73·0	41·4	35·1	2·51	1·57	69·7	78·9	42 8	33·2	3·37	1 59	71·7	94·0	47·7	38·6	0·08	0·97
Katanning	61·7	70·6	43·1	34·7	2·23	1·96	67·2	78·0	44·0	33 3	1 16	1 55	76·9	94·5	41 5	40·4	0·10	0·66
Cape Leeuwin ...	61·3	65·0	52 3	47·8	4·09	3 50	62·9	69·2	52·7	43·0	2·52	2 92	66·7	76·0	55·7	50 0	0·56	1·21

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